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NOTES ON FUNGI.—No. II.

WHITE-SPORED MUSHROOMS (THE RING-BEARERS).

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(With a Coloured Plate.)

Of the six divisions of the great genus Agaricus mentioned in my last article, that which is characterised by the spores or reproductive organs being white is one of the most important, from the number of esculent species which it comprises, though it does not include the true mushroom. Only one or two indeed ever appear in our markets, but the merits of several of the species are becoming more widely known every day, and on the Continent they yield an abundant supply of good and wholesome food.

The white-spored mushrooms, or Leucospori, are divided by Fries into eight sub-genera, Amanita, Lepiota, Armillaria, Tricholoma, Clitocybe, Collybia, Omphalia, Mycena, and Pleurotus, on each of which I shall have to make a few observations. The three first and a few species of the last division are in general characterised by the presence of a veil covering the gills and stretching from the stem to the edge of the pileus, either in an ascending or descending direction. It is true that in one section of Amanite there is no veil, but then there is a distinct universal wrapper, or, as it is called by mycologists, a volva, which alone separates the division from all the rest, for the universal veil in Lepiota is not distinct from the pileus. The first question then to be asked on examining a white-spored Agaric is, has it, or has it not a volva, distinct from the cuticle of the pileus. If the former is the case, we have an Amanita, and may at once proceed to discover to what species it belongs.

There is, indeed, some difference in the appearance of this

volva. Sometimes it is a distinct white membrane, which in an early stage covers the whole pileus, and which, as the plant swells, bursts and appears at the base of the stem as a lobed cup; sometimes a large portion of it remains on the pileus in the form of mealy or wart-like patches, while the free portion below is a mere rim; but sometimes, again, it is incorporated more or less with the base of the stem, being entirely irregular.

Now, every one who has paid the slightest attention to Agarics must be acquainted with the magnificent fly Agaric, which is such an ornament to our birch woods, with its bright scarlet pileus studded all over with white or yellow warts, and there is such a strong family likeness between the species that it is almost impossible to confound an Amanita with a species of another section.

Amanita * contains some of the most dangerous fungi, but it also comprises a few of the very best. *Amanita cæsarea* (Fig. 1), distinguished by its bright smooth pileus free from warts, its capacious volva, and its yellow gills, is confessedly one of the most delicious of fungi, and is the pride of southern markets, where it has been known from the times of the Romans, and is the Boletus of the Satirists, as from its pre-eminent qualities it was often made the vehicle for poison. This lovely species, which has a very close ally in the Himalayas, north of Calcutta, may some day reward the research of mycologists in the south of England or Ireland, as is the case with the coral-red Clathras. There is a species with white gills in Italy, *Agaricus ovoides*, which closely resembles it, which appears to possess almost equal excellence.

In England we have one or two which may be eaten when young, but it must be with caution, as the sub-genus contains several poisonous species. *Agaricus vaginatus*, which has no ring, and is remarkable for its highly developed volva, and the grooved margin of the pileus, which assumes various colours, though it has an evil report when fully grown, may, according to Vittadini and others, be eaten when young. It is, however, seldom abundant enough to be of any great consequence as an esculent. Dr. Badham considered *Agaricus solitarius*, which sometimes grows to an enormous size, as excellent, if in good condition, and this comprises, perhaps, all of the section which may be eaten with impunity. I should be sorry to sanction a trial of our more abundant species, even when young, as *Agaricus rubescens*, which sometimes grows in enormous quantities, especially in fir woods, where its red stains at once distinguish it. *Agaricus virosus* bears its own

* From ἀμανίτα, a name given to certain poisonous fungi, by Dioscorides and Galen.

bad character in its name, and *Agaricus excelsus* has almost as bad a report as *Agaricus muscarius*, whose narcotic qualities are notorious, a single specimen being quite sufficient to produce a very unpleasant degree of intoxication, for which purpose it is dried by some tribes in the north of Asia.

The species of the section, as said above, are recognized without difficulty, and without experience it is far better to abstain from so insidious a group, for we are sure not to meet with the true or white oronge, *A. cæsareus* and *A. ovoides*, except in the far south.

There is one small division to which the English *Agaricus megalodactylus* belongs, which may prove a puzzle, because the volva at length entirely vanishes, leaving the pileus smooth; but an examination of young specimens will at once decide the matter, and will distinguish it from the second sub-genus Lepiota, which derives its name from the scales (λεπὶς), which are so highly developed in most of the species.

Now, as said above, there is a universal veil in Lepiota as well as in Amanita, but in the latter it is evidently quite distinct from the cuticle, however closely united it may be, while in Lepiota it is completely confluent with it, and with it often breaks up into scales. There is another character besides that of the possession of a universal veil in which the two sub-genera agree, which is, that the portion of the pileus which bears the gills (hymenophorum) is perfectly distinct from the stem; and it is with reference to the distance of the base of the gills from the apex of the stem that they are said to be remote or approximate, and not to their distance from each other, as the student might at first suppose.

The portion of the universal veil which separates from the pileus leaves a more or less distinct trace on the stem, which is moreover encircled with the partial veil, which is concrete with the former or distinct, and either moves freely up and down, or is permanently fixed. The ring is said to be superior when it originates and hangs down from the top of the stem; inferior when it grows like a sheath upwards to the edge of the pileus; medial when its origin is distinct in neither direction. In a few species, there is a viscid coat; and in these consequently there are no scales on the pileus, though the stem is occasionally floccose.

Some of the species of this division are found occasionally in great abundance, as the tall *A. procerus*, which has the strongly bossed pileus covered with rough, coloured scales, and the bulbous stem spotted like a snake. It is one of the best of our Agarics, and yields an excellent, though not abundant ketchup. It is occasionally sold in Covent Garden Market; and *A. rachodes*, which is closely allied, but known at

once from every part turning a deep red when bruised, is a welcome addition to the basket of the mushroom gatherer, who is not very particular what he gathers so long as it yields a dark juice, though it is not so good for food, if indeed it is always perfectly safe. Three or four closely allied species occur in groves and pastures, the esculent characters of which have not been fully ascertained, but they are all probably harmless.

A. procerus and its more close allies, of one of which, *Agaricus excoriatus*, we have given a figure (Fig. 2), attain a considerable size. There are, however, several smaller species, some of which are doubtless wholesome, but some, as indicated by a nauseous smell, of dangerous character. They are, however, too small, and occur in too small quantities, to make them of any great culinary importance. I must not, however, omit to notice those which occur occasionally in large masses in hothouses, especially where spent tan is used. They are mostly extremely pretty, but of very suspicious quality, and one or two are probably of exotic origin. *Agaricus cepæstipes* occurs in Java in very nearly the same form as that figured in Sturm's *Deutschsland Flora*,* and it is probable that *A. meleagris* was also originally exotic. *A. rachodes* occurs occasionally in hothouses, where it is very ornamental. The scaleless stem forming a contrast to the very scaly pileus is very striking, and indicates apparently a specific difference from *A. procerus*. It must, however, be confessed that intermediate states occur which it is difficult to refer to either.

We now come to a third division, Armillaria (named from Armilla, an armlet), which has a well-developed ring, though there is no universal veil. The division is, however, rather artificial than natural, and the species might be classed with the three following divisions. Here the hymenophorum is not distinct from the stem, but confluent with it. If then, as Fries well remarks, the divisions are to be considered as generic, Armillaria must be rejected, and the species merge in Tricholoma, Clitocybe, and Collybia.

The species are not numerous, and in this country cannot be considered as of much importance in a culinary point of view. *Agaricus melleus*, however, which is one of our most abundant species on stumps where trees have been cut down, and which is known by its well-developed ring and honey coloured scales, is much eaten in some parts of the Continent under the name of Halimasch. It is, however, a detestable species, producing an unpleasant constriction of the œsophagus, and

* Fig. 3 is copied from a drawing made by Herr Van den Bosch in Java, and forwarded to me by Dr. Anderson from the Calcutta Botanic Garden, amongst many other interesting matters.

in all probability in many cases must lead to unpleasant consequences. Salt and vinegar, which are so much used in Eastern Europe, especially in Russia, as a pickle for Agarics, neutralise, in all probability, the deleterious alcali. There is no chance, indeed, of any one in England, except by way of experiment, cooking so uninviting an Agaric, which may therefore be dismissed without any scruple. In Sweden it is justly neglected, and Fries does not give it a word of commendation, though he says that it is esculent.

A very beautiful species, *A. mucidus* (Fig. 4), occurs on beech trees in the southern counties, being a sure indication of imminent decay. The viscid, pure white, or slightly ash coloured pileus and distant gills, together with the highly developed ring, readily distinguish it.

The figures of *Agaricus cæsareus* and *excoriatus* are copied from Vittadini, and that of *A. mucidus* from the Flora Danica, as my own original sketches of the two latter species are not at present accessible.

LONDON BIRDS.

BY SHIRLEY HIBBERD.

THOUGH London grows at such a rapid pace, that it threatens soon to cover the greater part of the county of Middlesex, nature is very beneficent, and has hitherto resisted the complete eclipse by dirt which the speculative builders appear to have had in contemplation. It was said by Leigh Hunt (or somebody else), that you could not proceed far in any direction through the City of London without seeing a tree; and to that it may be added, that you can scarcely proceed a single yard anywhere in the City, or in parts more close and crowded, without seeing a bird. London is, indeed, far richer in birds than it deserves to be. The municipal authorities and the parochial and district boards rarely expend a penny or bestow a site for the planting of a tree, the open spaces are for the most part disgracefully filthy and desolate, and consequently there is little encouragement within the town itself for birds of any kind. In the suburbs it is otherwise. Nowhere in all England is gardening pursued with so much ardour, and generally with such good taste. As we proceed outwards from London, no matter in what direction, we see the gardens beautifully planted; and the soil being everywhere good, trees are plentiful and birds abound. A few birds, however, seem to be

specially adapted, not merely for London as viewed from without, but for London *par excellence*, that is to say, for the smoky, noisy, almost treeless City; with these for pioneers, nature invades the Stock Exchange, the Court of Aldermen, the Bank, and all the railway termini, as if to say, "Shut me out *if you can.*"

Of what race or descent, of what origin or history, are the Guildhall pigeons, I know not; but if any naturalist inquires after City birds they claim first mention, and might well have a place in the civic emblazonment of arms. The first birds it was ever my lot to keep, when a very small boy, were a pair of pigeons that were trapped for me by a young friend, who lived within a stone's throw of the Guildhall. They were sent in a basket to Stepney, and there I made for them a large cage by placing laths in front of an empty box, and the box was hung up in the garden close to the kitchen door. In due time a pair of young pigeons came forth, and the *Penny Pigeon Book*, which I used to pore over in hope of learning the whole art and mystery of the pigeon fancy, told me that as soon as they had young I might allow them to fly; they would never leave the spot where they had young to care for. So, on the first day of the chicks coming out of their eggs I drew away one of the laths, and away went both the birds. They circled round to reconnoitre, as is the custom of pigeons, and then they took a direct flight westward, and were never seen in Stepney more. My friend averred that he saw them come home, for the young thief (he is now an eminent citizen) spent all his time watching the Guildhall pigeons, and to confirm his statement, he offered to entrap that identical pair again any day if I would have them. But I never did have them, and never wished for them. The little ones died in my lap, wrapped up in flannel; and that was the first and last of my experiences in pigeons. It is very rarely any one has the audacity to trap or harm a City pigeon. They are as sacred as storks in Holland, and the birds of good omen that built in the temples and residences of classic Greece. They are the pets of policemen and railway porters, and woe to any one found engaged in devices for their destruction. Those met with elsewhere in the City, appear to be colonies originally sent out from Guildhall. There is a large colony at the terminus of the South Eastern Railway at London Bridge, and greatly do the porters and the drivers of public vehicles rejoice in them, and kill time when waiting for incoming trains by robbing the horses' nosebags to feed the pigeons. At the Royal Exchange there is a small colony, but it is fast increasing. Their breeding-places are principally the capitals and cornices, but they are not particular. Any place that affords a little

shelter suffices, for safety they seem to have little care; familiarity with the noise and bustle of the City renders them fearless, and you see them foraging under the heels of horses and along the line of cab ranks with much the same nonchalance as those mysterious ragged urchins who swarm about the pavement of the Exchange, and live no one knows how.

Next to the pigeons, the City sparrows claim attention. They are a sooty race, inured to City life and usages, and exhibit in their habits an indefatigable determination to "get on." During the mid-day hours, when Cheapside is in a constant tremor with the clatter of hoofs and vibration of wheels, the sparrows are as busy as the people. If there be but for an instant a blank space in the roadway, down drop half a dozen and forage with furious impetuosity among the droppings of horses for scraps of undigested grain, and for the flies that settle on the disjecta even more quickly than themselves. You may observe that they calculate almost to an inch and a second their escape from the next team, alighting on the nearest window sills, and waiting to descend again the next moment any blank occurs. There are very few City houses that afford accommodation for sparrows to nest. The builders take the best care to prevent their gaining a settlement anywhere, for they damage the properties they select for their habitations much more than is generally supposed. The boxes placed at the summit of water spouts, where the rush of water from the roof finds its way from the slope to the perpendicular, are their usual nesting places; and when the next heavy rain comes the nest stops the way, and the water leaps over the top of the spout and comes down sputtering on the pavement in an inky flood. Then a plumber is sent for, a ladder is placed, and presently a conglomeration of hay, straw, rags, shoe-strings, bits of paper, tufts of hair (human), strips of parchment, corks, bristles, and other rubbish is dragged out, with mayhap, if it is the right season, eggs or callow young, and an end is unceremoniously made of Mr. and Mrs. Chirk's establishment; and that removed, the water betakes itself to its proper channel. But the majority of the City sparrows build about churches and large public buildings. The sparrow is a public character, and loves the neighbourhood of boards, vestries, committees, and people who dine gloriously; for these happy folks have not only plenty of brickwork, and warm chimneys, and gable ends, and cornices, and architectural pockets; but they have also a few trees or a bit of garden hard by their places of assembly, and these suit the sparrow, who loves a bit of country even when gorged with refuse from the "Albion." The love of sparrows for trees is well known by Londoners. There are certain spots

especially favoured with patches of green umbrage, and wherever there is one fine tree or an imposing group of trees, there also will be established what in London is termed a "Sparrow's Chapel." In the garden of the Bank of England are some noble lime trees, and soon after daybreak a sweeter music issues from their leafy branches than the chink of coins which comes afterwards in the penetralia of that august establishment. At the corner of Wood Street, where there was once a rookery, there is now a grand chapel in the tall plane tree there. The trees at the foot of Southwark Bridge (Middlesex side) resound with the chirping of a thousand sparrows, every morning and evening all the year round. There is a small twitter among the plane trees of Bucklersbury, but it is too small to give the place any claim to be called a chapel. Tower Hill is great in sparrows, and the Tower itself is a sort of Cantelo hatching apparatus for the brood of impudent foragers that almost deserve to be described as mice with feathers. But there are two grand sparrow chapels (there may be hundreds): one in Wilton Crescent, Belgravia, where there is a tree that affords a thousand perches for a million chirpers; the other is a fine old poplar at the northern extremity of Goswell Road, at the junction of Goswell Road and City Road, fifty yards south of the Angel, Islington. At dusk and daybreak, these two spots are like fairyland. The sparrow is no songster unless taught, and then a tolerable musician; but the untaught melody of the myriads that assemble in these trees for matins and vespers is by its volume almost sublime. They seem to come from all quarters at the hour of meeting, as pertinaciously and as solemnly in garb as Quakers, but the very antipodes of that sect in volubility; and they literally make the welkin ring spite of the roar and rumble of cabs and omnibuses. Their song is all to one tune, *simul et semel;* and this they sing with all their might, and, like the great Kœnig of brazen memory, the compass is limited to two or three notes.

One can understand that pigeons and sparrows are at home in London. The fact is, the place is full of food for them. But it is hard to understand why rooks should cling so pertinaciously to their ancient homes. No one ever saw rooks build on housetops. They must have trees. And in a great many of the spots where large trees still remain, there rooks do still congregate. Yet among the rookeries there is no parallel to the misery which is too common a characteristic of those abodes of the outcasts of the human family, which strangely take the same name: no, the rookeries of Gray's Inn and Spring Gardens are agapemones, they are abodes of peace and plenty; no one hurts the rooks in London; the only smell of

gunpowder they are familiar with is the occasional curl of smoke from a volunteer review, and to traps and gins and poison, aye, to persecution of every kind, they are happy strangers, held in a kind of sanctity, as precious living relics within the town of the glorious world of greenness that lies beyond. The rookery in Holland Park, Kensington, one of the most ancient in the land, is still in fine feather, and the clamour there is just now being renewed, and the air resounds the whole day long with the harsh "caw, caw," that tells unmistakeably of their anti-malthusian propensities. In that delightful collection of personal reminiscences, *London Scenes and London People*, by "Aleph," there are some amusing anecdotes of rooks and rookeries in London. We are told of the "famous rookery in Carlton House Gardens; but when, in 1827, the trees were cut down, the rooks emigrated to a plantation at the back of New Street, Spring Gardens. * * * There is a rookery near Kensington Palace. Taking a long stride into the heart of the City, we find a rookery in the south burial-ground of St. Dunstan's in the East, Tower Street. Before the old church was pulled down, there were at least twenty nests; and the kindly parish officers annually supplied them with osier twigs and other necessaries for constructing their homes. When the church was removed, in 1817, the disturbed rooks took refuge at the Tower of London, and rather ambitiously built in the White Tower;* yet they were unable to reconcile themselves to the change; and no sooner had the workmen left their former haunt, than they returned to their ancient quarters. In 1849 the kindness of the authorities was again extended to them, their nest-making being aided by Mr. Crutchley, the assistant overseer. They built in some venerable plane trees." It is rather odd that the author of *London Scenes* should know of the rookery that once existed in the large elm trees behind the Ecclesiastical Court, Doctors' Commons, and yet not know of the last chapter of its history. A mischievous fellow living in a ten-pair back overlooking the rookery, furnished himself with an air-gun, and from time to time popped off the rooks with noiseless missiles. In another ten-pair back dwelt an observant philosopher, whose curiosity was awakened by seeing the rooks fall from time to time without visible or audible cause. That observant philosopher communicated to the Royal Society that rooks were subject to the *falling sickness*, and to this disease, of which the air-gun was the unknown predisposing cause, is to be attributed the extermination of the rooks that made a clerical "caw" from their clerical throats in that sanctuary of

* Which belies the remark of mine just above, that "No one ever saw rooks build on housetops."

ghostly intentions. The most noted of all the City rookeries was the plane tree at the corner of Wood Street, Cheapside. It is a rookery no longer; when the rooks finally quitted it no man can tell. I tried to discover when the rooks were last seen there by a query on the subject printed in the *City Press*, but there was no response. Mr. Alfred Smee, in his volume on *Instinct and Reason*, says there were four nests there in 1850. I saw *birds* there in 1858, but have never seen them since; but yet at the present time one nest remains, and it is, I believe, annually occupied by sparrows.

The transition from rooks to daws is easy enough, for they are boon companions. Yet daws are nowhere seen in the heart of London, except at the Tower, where there are always a few. In the immediate suburbs, however, daws are tolerably plentiful wherever there is an old architectural pile, be it church, mansion, or what else, for them to nest upon. Our pretty old village church, at Stoke Newington, has a few daws for inhabitants, and, from the noise and fuss they make in the early part of summer, one might think the very atmosphere to be made of daws, so clamourous are they, and so active in rushing to and fro. I know that they watch for my small annual crop of walnuts—I have but one walnut tree—and generally manage to carry off all the nuts just at that critical moment when they are ripe enough to be eatable, yet not ripe enough for use. It is the same with my neighbour, Mr. Dobinson. He has a fine tree that bears plentifully, and the daws gather the produce as regularly as a landlord comes for his rent. I expect the folks at Kensington are equally unfortunate in walnut culture, for, last summer, I saw a lot of daws sailing along over the houses in High Street in the direction of the church; and I remember that, when a boy, at Stepney, we used to throw cricket balls at the church clock, and now and then get a daw's nest by climbing up the old flint buttresses, saying the Lord's Prayer backwards, at the same time, to raise the Devil, a sort of killing two birds with one stone, though the "killing" was, in one case, a quickening, and we used always to drop the nest with fright as soon as we had made a clutch at it, fancying we heard the footsteps and smelt the sulphur of the darker party as we finished the incantation. The jackdaw is, in fact, a common London bird, though a stranger to the City.

Now that we have got to the suburbs, birds abound. In all the gardens, especially on the south, west, and north, the song thrush is one of the most plentiful of birds. On the eastern side of London song birds are rather scarce, though in a few favoured spots, as at Bromley by Bow, and in the more rural parts of Homerton and Hackney, the thrush is still a

constant resident. The blackbird is more scarce, yet at Stoke Newington, Stamford Hill, and Highgate, on the north; and at Dulwich, Battersea, and Wandsworth, on the south; it is commonly seen and heard, and builds and breeds without fear, wherever there is a sufficient amount of seclusion. Westward I have never seen the blackbird nearer London than Uxbridge, and beyond that point blackbirds are almost as plentiful as blackberries. The storm cock is a rare bird everywhere near London, but is occasionally seen at Stoke Newington. As for the robin, it is not a London bird in the same sense as a haymaker is not a Londoner. But as you may see haymakers in London, so you may see robins; its indomitable pluck and its solitariness of habit will carry it anywhere. Robins are seen among the hay-carts at Whitechapel, Smithfield, and Cumberland markets, in all the squares, in Lincoln's Inn, Gray's Inn, and other gardens; in the open roadway of Farringdon Street, Ludgate Hill, the Strand, and Blackfriars Road; nay, I once saw a robin on a lovely autumn afternoon perch upon the edge of a tombstone in St. Paul's Churchyard, and trill out a carol as sweetly as in any rural nook at home; and I think I may say, that of all the crowd then within seeing and hearing, I was the only one that saw and heard, for when the bird ceased, and I turned round to pursue my way, there did not appear to have been a single soul conscious of the angel visit but myself.

I am afraid that at this point we have done with true London birds. Yet it is hard to quit the subject. I call to mind that here (Stoke Newington), one of the commonest and most welcome of songsters is the hedge accentor (*Accentor modularis*, Cuv.). I never see it in the squares or real London gardens, yet it abounds in all the suburbs, wherever in fact there are gardens sufficiently large to separate houses by the distance of a hundred yards or more, if those gardens contain old hedges, or clumps of scrub, and wilderness. So with the wren, common enough in all real gardens, I never saw it nearer town than Pentonville, and there I have seen it with my own eyes. But very scarce near London is the fine crested wren, it is indeed a *rara avis*.

Among the visitants, the blackcap must take precedence for plentifulness. It is the precursor of the nightingale, and tells us that surely spring is come at last. At Dulwich, Hornsey, Kensington, and St. John's Wood the blackcap may be heard every season, soon after the last days of March; but it makes its way only into such of the more urban districts as enclose within their boundaries much rural scenery. Soon after comes the nightingale, who haunts many more localities of the London suburbs than the sleepy Londoners are aware. Strike

a radius of three miles from St. Paul's in any direction, except due east, and find at the termination of the radius some spot where there are tall elms, avenues of limes, orchards, or well planted gardens, and there, if you have ears, you may enjoy, any time during the month of May, the nightingale music. And here it occurs to me to make a special note on London songsters, that many true British residents are true migrants as to London; and all the true migrants come into song later near London than elsewhere throughout the land. I have heard the nightingale on the 2nd of April at Ringwood, Christ Church, and Minster, in Dorset; but never before the 15th or 20th at Stoke Newington. Shall I tell you that my heart leaps within me to know that the builders, spite of their desperate efforts, have not yet driven this queen of British song birds from our district. The nightingales sung in Lordship Road and over all our gardens, reaching as far back as Clissold's Park, all through the season of 1864, just as if builders were nonentities, and new bricks were as poetical as old trees, which we all know they are not. At Stepney, Bromley, Bow, Old Ford, and Stratford, the nightingale is unknown except in books. Elsewhere in the three-mile circle it is a constant visitant; it loves trees, is rarely hunted by cats (which destroy many thrushes), and has but one terrible enemy, and that is the birdcatcher.

The chaffinch, bullfinch, goldfinch, and linnet, are all migrants in and about London. They "come like shadows, so depart." Sometimes the air rings with the delicious but brief and monotonous song of the chaffinch for days together during May and June, and then we see no more of them for months. So with the bullfinch; they come down on the fruit trees like swarms of locusts, eat their fill, and go away fat as butter. As for the goldfinch, it is the rarest of all the finches near London; to see a group of them in late summer haunting a patch of thistles, or taking toll in the kitchen garden where there is a good crop of lettuce seed just ripe, is to have reasonable occasion for making an entry in one's diary. The linnets behave in a similar manner; they come in clouds in autumn, twitter, and disappear. Starlings come at all seasons, but most of all in winter and spring, and then always in large flocks, so that those who are wicked enough to shoot them may fill a bag at every pull of the trigger; that is if they can hit a haystack, which few cockneys are able to do. Now and then, during winter, I see that rare but lovely little oddity, the siskin. During the past few months several have appeared here, and as of yore always careless, merry, full of antipodean feats, and singing a song which is the most comical ever heard out of an avicular larynx. All the tits haunt the London suburbs, and

most interesting birds they are. The most common is the coal tit, a true acrobat, and a very sociable, innocent creature.

Swallows make their way pretty well into the heart of London, but not as in White's time are they met with in Aldersgate Street. There are nests to be seen in the older parts of Kensington, Lambeth, Kentish Town, and Stoke Newington, in plenty. Knowing the last-named spot I can tell you that in High Street, nearly opposite Church Street, there is a long file of swallows' nests under the coping-stones of the houses kept by Mr. Engisch, Mr. Davidge, Mr. Rumney, and thence northwards, and all the summer long the birds dart to and fro, over the tops of omnibuses and loaded wains, up the defile of Church Street, and over the beautiful expanse of Abney Park Cemetery, in apparent unconcern as to the noise and traffic. At the other end of Church Street, where the bold sweep of the New River, skirting Newington Park, makes "a silence all day long," you may see not only swallows, but swifts, and the nests of these latter are to be found on the upper parts of the fine old houses which overlook the Park at that spot; and thus within the distance (as the crow flies) of three and a-half miles of St. Paul's, are all the elements of rural life, and the aspects of the place are, as yet, those of a country village.

I should have concluded here had I not suddenly called to mind that the flycatcher has built in these gardens within three years past; that I used to trap redpoles in a field at Stepney, where is situated now the Metropolitan Cemetery; that, towards the approach of winter, and sometimes late in the spring, flocks of wild geese go over head, in wedge-shaped masses, crying as if for fear to find themselves in such dangerous proximity to smoky chimneys; that wood-pigeons often come over these gardens in flocks in autumn (a friend who resides at Tottenham, reckons on a few pigeon pies thereby every year); that fieldfares and redwings are seen in the open meadows every year in October and November, and fall victims to the fowler's gun; and that jays, magpies, crossbills, and hawks of all kinds are rarely or never seen at all within at least seven miles of the mighty Babylon.

AURORAL ARCHES.

It will be interesting to compare the accounts of the remarkable auroras recently seen in Scotland with descriptions of similar phenomena observed in other places.

The following passages are extracted from the *Daily Review* (Edinburgh) relative to an auroral arch, on Wednesday evening, the 15th February. They occur in two anonymous letters addressed "to the Editor."

1. *Penicuick.* "There was observed on Wednesday evening, the 15th February, an extremely rare phenomenon. About half-past eight on the evening in question an arch appeared, spanning the heavens from N.E. to S.W., and, what is unusual, its path was directly overhead for the first half hour. At either extremity it ended in a point about 8° above the horizon; and it gradually expanded until it reached the zenith, where it attained a breadth of about 5°. It was throughout brilliantly white, and contrasted remarkably with the blue sky. It was quite transparent except at the extremities, the stars shining through it; and the night being cloudless it was of singular beauty and grandeur. After the first half hour the arch began to decline towards the south-east, and by half-past ten it had lost much of its brilliancy." —C.

2. *Edinburgh.* "For volume and power of light the phenomenon of Wednesday night, the 15th February, far exceeded any single streamer of the Aurora Borealis. The arch ran east and west, almost directly overhead, and stretching out to both horizons. The shape presented to the eyes of most persons was that of a dead straight line of brilliant light, at first yellow, but when it commenced to melt out of sight, of a silvery hue. It resembled a magnificent javelin horizontally suspended over the city, and produced at one end to a point in the horizon directly beyond Holyrood, at the other to Corstorphine Hill. The light at first surpassed that of the Comet of 1858, and there was an entire absence of motion in the luminous pathway; nor did it change its direction in the least in the last half hour of its existence, as was proved from bearings taken of it when first seen."—X.

Mr. J. Anderson, of Pratis, Fifeshire, in a letter to the *Fifeshire Herald*, exclaimed concerning the same aurora—"The wondrous beauty of the arch on Wednesday evening can hardly be described. It seemed a heavenly pathway of gold, shedding its brilliant light across the land, and leading

'Right onward to the golden gates of heaven.'"

Similar arches to that described were seen on the 29th

March, 1826, near Nottingham, and on the 22nd of March, 1841, at York, Durham, etc., when the height was estimated at more than 150 miles from the observations of Professors Chevallier, Phillips, and Stevelly (Lowe's *Treatise on Atmospheric Phenomena*, p. 144, et seq.). A similar arch was observed at Edinburgh on the 27th August, 1846, and an auroral band of the same kind observed by Mr. E. J. Lowe at Nottingham, and by Sir J. Herschel, at Hawkhurst, in Kent, on the 9th March, 1861, was estimated by the latter to have been eighty-three miles high midway between the two places, or over a place thirty miles north of London. Finally, a similar arch was observed by Professor Challis, at Cambridge, on the 21st February, 1862, which was vertical at Newark, in Lincolnshire, but other observations were wanting to determine the height of this arch.

It appears from these instances that such arches are most common in the months of February and March, and that they vary from 80 to 160 miles in their height above the earth.

We append a description, furnished by Mr. Herschel, of the appearance of the Aurora Borealis, as seen in Kent in the month of January last.

"1865, Jan. 28th, 7·35 p.m., Edenbridge, Kent. Two arches of the Northern lights appeared in the N.W., bright and colourless, the uppermost 7° or 8° above the horizon. Both preserved their brightness for a few minutes only, when the uppermost arch merged into the lower arch, resting together upon a black segment not more than 2° or 3° high. This black segment was cloud, for stars of the third magnitude setting behind it were immediately eclipsed.

"9·35 p.m., Hawkhurst, Kent. In four or five seconds of time an army of small streamers shot upwards from the border of the dark segment to a height of 10° in the north. These were yellowish, and covered an area of 10° or 12° in azimuth; they immediately began to course each other rapidly across the area from west to east, so as to run over the whole width of the area in less than one or two seconds, when, disappearing in the east, they were replaced by new streamers in the west. This running motion was renewed at intervals (for a few seconds at a time), until, in less than two minutes, the streamers subsided as quickly as they came, and disappeared. The arch and segment afterwards became less distinct, and no other display occurred until 11·30 p.m., excepting a wide diffuse streamer of brief duration at 10·50 p.m.

LEPIDOPTERA FEEDING ON FERNS.

BY M. G. CAMPBELL.

All along the shady side of my small garden, situated in the heart of the town, I have planted British ferns. Trees and a low wall screen them from the sun, as well as shelter them from wind. Early in the summer before last, I observed one of my lady ferns, *Athyrium filix-fœmina*, partially eaten by some insect. I searched for the depredator without success, until after giving the whole plant a thorough shaking, when two or three larvæ of the Great Tiger Moth, *Arctia caja*, fell to the ground. I took up two of them, and confined them in a box, covering it with green gauze, and there I fed them, not with my ferns though. I gave them what I knew they would eat, namely common plantain, *Plantago major*, as, accustomed for years to feed large numbers of lepidopterous insects, nocturnal and diurnal, the little furry-coated gentleman was no stranger to me; but, as my habit is, I like to prove everything for the satisfaction of others as well as myself.

In this cage they were by no means unhappy. They feasted on the fresh food supplied to them twice daily, increased in size, performed their due moults, changed into the pupa state when fully grown, and eventually evolved perfect imagoes of the *Arctia caja*, their gorgeous wings even more brilliantly coloured than usually found when roaming free, because they had been sheltered from the effects of wind and rain, and those wings are now displayed in one of the drawers of my cabinet, pinned on to its cork lining.

But what of my ferns all this time? After securing the first intruders, I did not again examine my ferns for three or four days, imagining I had all the mischief-makers in safe custody. But when about the fourth or fifth morning I went to look at them again, what was my consternation to find that my Athyriums, which had but a week before looked so lovely in the tender green of their lacy beauty, were completely eaten away, all but the primary rachis, and the branchlets, or secondary rachids issuing from it, which presented the appearance of so many dry threads, almost every atom of the soft, green, leafy portion of the plant being stript from it. Several fronds of a *Lastrea filix-mas*, which stood near, had also paid tribute. On the small bit which remained of the laminar portion several of the "Woolly-bears" were busily at work. I shook the ferns well, sweeping them in all directions with my hand, and the caterpillars fell from them in multitudes. They reminded me of nothing less than the plagues of Egypt. Morning

by morning for weeks myself and a servant hunted them out, and it is not too much to say that we often took from twenty-five to thirty of these intruders from a single plant, although the day before we had thought there could not be one left, so careful had been our search. I had been proud of my ferns, but my pride was sadly humbled; and all unwilling as I am to kill anything, I was obliged to allow these devourers to be crushed.

Last summer again the same thing happened. They came in incredible numbers. Before I was aware, they had again despoiled my Athyriums of every vestige of green, and in order to save my remaining ferns, we were compelled again to perpetrate a daily massacre.

Their plan was, each year, to attack the Athyriums first, then *Lastrea filix-mas*, after that the other Lastreas, then the Royal Osmunda, and when these failed, but not till then, they were not too dainty to try *Polystichum lobatum*. The Polystichums were always the last in requisition, they evidently preferred something more tender. I hope next summer they may take it into their heads to commit their depredations elsewhere than in my garden.

THE ACHROMATIC TELESCOPE, DIALYTES, AND FLUID LENSES—NEBULA—DOUBLE STARS—OCCULTATIONS.

BY THE REV. T. W. WEBB, A.M., F.R.A.S.

In several previous papers we have endeavoured to give a tolerably comprehensive idea of this beautiful invention; but a few particulars, not unworthy of notice, yet remain.

The chief impediment to the manufacture of object-glasses of sufficient aperture to compete with the light-grasping power of large reflectors, used to be the want of homogeneous flint-glass; the salt of lead which is employed in its manufacture, and which gives it its superior dispersive power, having a tendency from its weight not to mix uniformly with the other ingredients, and if intermingled by mechanical means, to form streaks and veins very prejudicial to neat definition. Small discs might easily be procured, but with increasing size all kinds of imperfections increased with fatal rapidity, so that, as recently as 1820, lenses of five or six inches were scarcely procurable. In order to obviate this serious evil a remarkable modification was devised in the year 1828, by Sir

John Herschel's tutor, Mr. Rogers.* In this construction the object-glass is a single plate lens, and the correction of the two aberrations is produced by a combination of a plate and a flint lens interposed in the cone of rays before they reach the focus. To comprehend the method of doing this, we must consider what would be the effect of placing together two lenses, one convex and one concave, of equal focal lengths. Then, if each were of the same kind of glass, or of glass having the same amount of dispersive action, the rays would pass through quite colourless; but if their dispersive powers were unequal, though the general mass of rays would still be transmitted parallel, yet colour would be produced in proportion to the inequality of the dispersions, and in the direction of the stronger of them. In the case, therefore, of a plate convex and flint concave of equal foci, there would be colour due to the superior dispersion of the flint, and acting in a concave direction, or opposite to that of the object-lens. Now, supposing this uncorrected colour to be equal in amount to that of the object-lens, it is plain that if the two lenses producing it were placed immediately behind the object-lens, they would destroy its chromatic aberration, and we should have a combination similar to Dollond's triple object-glass already described (INTELLECTUAL OBSERVER, vi. 451). This, of course, would require the flint disc to be of the full size. If, however, we could increase the amount of the dispersion produced by the two combined lenses, we might remove them from the object-lens towards its focus, to a point where its convex or positive dispersion, increasing as it departs from its source, would be exactly balanced by their negative excess of colour, and since the cone of rays would there be smaller, we should gain in respect of the size of the flint lens exactly in proportion as we could remove it from the object-lens. But as the excess of concave dispersion in the two combined lenses, which we may collectively term the *corrector*, depends entirely upon their focal length, we have only to shorten their foci, in order to increase the excess of dispersion to any required amount; and thus *in theory* an object-lens of plate glass, however large, may have its colour corrected by a disc of flint glass, however small. In practice, however, a limit would soon be reached, as the deepened curves required to produce the shortened foci would introduce too much spherical aberration to be even approximately corrected; for it is only with very small segments of a sphere, as

* A similar idea had, it seems, occurred several years before to Sir David Brewster, who had described and constructed lenses of this kind, and perceived their applicability to telescopes; but he admits that the invention was original on the part of Mr. Rogers. The late Dr. Dick stated that a four-inch achromatic was actually constructed on this principle with success by Mr. Wilson, of Glasgow, before he was aware that Mr. Rogers had proposed a similar plan.

we have already observed, that this kind of compensation can be rendered perfect; and hence a moderate ratio between the apertures of the object-lens and corrector is preferable; if we assumed one-half, which would give very practicable curves, we could still employ a flint disc of only four inches (or a little more, in order not merely to take in one point, but some extent of field) to correct an object-lens of eight inches aperture.

This construction, as compared with the ordinary double achromatic, is attended with several advantages and disadvantages. The latter are obvious: the loss of light, perhaps 12 per cent., from two extra reflections and one transmission, and the greater chances of error in centring and working two additional surfaces; and, besides these, which are common to it with the triple achromatic, there is less possibility of correcting pencils oblique to the axis, and much difficulty in preventing the corrector from getting out of that perfect adjustment with the object-lens which is absolutely necessary. Flexure, too, in the tube would, from the position of the corrector, be more prejudicial; and this has been found an annoyance even in the ordinary achromatic when the tube is of great dimensions; it was noticed by Airy in the magnificent telescope of Poulkowa, and no wonder, since in an experiment by the German optician, Reichenbach, a 24-pounder gun was found to exhibit very sensible flexure when suspended by its centre. But to these defects are opposed great and peculiar advantages; not merely the diminished size of the flint disc, which, in the present totally changed state of the manufacture, is of much less importance, but an experimental mode of final correction, which the constructors of the ordinary achromatic would often be happy to have in their power. For while it is difficult in the usual form to ascertain the precise ratio of dispersion in the plate and flint, and a slight mistake may require the reworking of one of the lenses, in the dialytic construction it is only necessary to obtain a near approximation as to dispersion, the final correction being, as will be readily seen, more easily and accurately accomplished by varying the distance of the corrector from the object-lens, till the most perfect achromaticity is obtained; while, as regards the spherical aberration, this, when such curves have been given to the correcting lenses as may be expected to neutralize it, may in like manner be finally destroyed experimentally by separating the lenses to a short distance from each other. Such at least was the opinion of the inventor, Rogers. The possibility of this latter ultimate adjustment has, indeed, been questioned on mathematical grounds, by an eminent writer on these subjects, Santini of Padua; but Rogers's conclusion was

not only founded upon a self-evident principle, but (unknown of course to Santini) was actually found to answer perfectly in practice. In addition to these conveniences it possesses another of considerable importance. We have supposed the corrector to exert merely a concave dispersion, without general refractive power; but this is by no means necessary. Its curves may be so proportioned as to give it a concave refraction also; the result of which will be the enlargement of the focal image, or, which is the same thing in practice, the shortening of the instrument materially, with the same aperture and magnifying power.

Possessing advantages so much more considerable, on the whole, than its defects, it seems remarkable that this construction should have attracted so little notice. It was carried into effect by Dollond, for Rogers, on a scale of five inches, with success; but I have not heard of another instance of its being even attempted in this country till of late years one was worked by an excellent optician, Wray, for Mr. Buckingham, the constructor of the magnificent achromatic of 20 inches aperture, and about 30 feet focus, which made so conspicuous an appearance in the nave of the International Exhibition. It had 8¼ inches of clear aperture, and its possessor has spoken very highly of its defining quality. But with these exceptions, it seems to have been ignored in England. On the Continent, however, its advantages were more fully appreciated. At the recommendation of the celebrated German mathematician, Von Littrow, it was taken up towards 1833* by an optician of Vienna, named Plössl, by whom a great number have been constructed, and some of considerable magnitude. About the year 1850 one was completed of 6·4 inches for Jassy, another for Biczke of 8·5 inches, and another for Athens of 8 inches. The latter has now been for some years under the charge of the celebrated Dr. Schmidt, who does not, however, speak very favourably of its present condition. One of 6·4 inches was also ordered for the magnificent establishment at Poulkowa. The Baron Dembowski, well known as a very industrious and careful measurer of double stars, employed one for a long time at Naples of 5½ inches aperture, and 5 feet 4 inches focus, which would perfectly separate ζ Boötis, and elongate γ^2 Andromedæ. His subsequent adoption of an ordinary Merz achromatic of larger size (see INTELLECTUAL OBSERVER, vi. 59), may however be taken as a tacit preference of the other construction. But the *chef-d'œuvre* of Plössl appears to have been an instrument made for the Sultan about 1851, which had an aperture of fully 11 inches, and focal length of

* Herschel's date is 1829, when perhaps it became generally known, but that in the text is from a contemporary publication by Gruithuisen.

11 feet 9 inches, and with a power of 610 would divide γ Coronæ Borealis, 0″·6, 4 and 7 magnitude. This seems to justify Von Littrow's opinion, that it might set itself boldly in competition with the productions of the best workshops in Europe. It would be interesting to know what may have been the subsequent fate of this noble, but, as may be apprehended, most unfortunately destined instrument. The neglect with which the construction has been treated in England seems matter of regret. It is true that some of our first opticians look unfavourably upon it, but it has never had the advantage of a trial at their hands. Many of Plössl's smaller instruments bore a very high character. Prof. Schumacher had one of 25½ Paris lines aperture, with powers 60 and 86, which would separate ϵ Boötis, and which was thought by Struve I. and himself superior to anything they had seen of that size. Sir J. Herschel's opinion, too, that it is "a very artificial and beautiful invention, highly deserving further trial," ought surely to lead to a more practical inquiry into its capabilities; and this, our readers will be glad to find, has been undertaken by Mr. H. Ingall, with much prospect of success.*

The dialyte, however, was not the earliest attempt to obviate the difficulty arising from the scarcity of large discs of flint glass. We have given it priority, because its construction with glass alone follows most easily from that of the common achromatic, but it had been anticipated by an ingenious contrivance of Prof. Barlow. This celebrated mathematician had perceived that, as our readers will readily understand from what has been said of the dialyte, a material possessing a stronger dispersion than flint glass might be set back from the object-lens by a distance corresponding with its chromatic power, and such a material he found in sulphuret of carbon. This extraordinary fluid was just suited to his purpose from its perfect transparency, absence of colour, and high dispersive quality; and to form it into a concave lens it was only necessary to enclose it between two discs of glass, each wrought to the requisite curve, but with parallel faces like a watch-glass, so as to have no refractive or dispersive action. These were applied to the two opposite sides of a third disc, which being wrought to corresponding curves exactly coincided with them, but whose centre was bored out so as to convert it into a broad ring. The three discs and the fluid being all gently warmed to a temperature higher than any likely to occur in practice, the ring was placed horizontally upon one of the discs,

* M. Valz, the ex-director of the Observatory at Marseilles, had undertaken the construction of two dialytes, with apertures of about 7½ and 15¾ inches; but their execution was frustrated by his retirement (an unwilling one) in 1863.

and the other slipped on one side so as to leave a small portion of the interior of the ring open; through this the fluid was poured in, and the upper disc slipped over it into its place. The subsequent contraction of the fluid in cooling would leave a vacuum-bubble, which was kept out of sight by allowing the ring an extra amount of aperture. Cement with tinfoil or paper being applied round the edges, the lens was rendered complete and permanent; and being placed like the corrector of the dialyte would have a similar effect in all respects, excepting the invariability of the spherical correction. In 1827 Barlow constructed a 6-inch telescope of this kind, and in 1829 one of 7·8 inches, with a satisfactory result. A subsequent attempt with eight inches, undertaken in 1833 for the Royal Society, proved a failure; and such might be considered my own humble imitation in 1830, with four inches. It served me, however, for four years, with tolerable achromaticity, but much uncorrected spherical error. Whether the plan may have been tried by others, I do not know. Several limpid fluids have since been discovered whose properties might merit investigation, especially chloroform, which from its density seems to promise well.

But we have not yet mentioned one very serious drawback, affecting more or less every one of the constructions already described. Not one of them answers to its name. They are not "a-chromatic," *i.e.*, colourless; and no workmanship of man can render them so. However carefully the correction may be adjusted, there is invariably a fringe of colour surrounding every bright object in focus; and a single glance with a high power at the planet Venus will make it visible, or even at the foliage of a dark tree against a white cloud or bright blue sky. This uncorrected fringe, or "outstanding colour," is a serious drawback to the beauty of the telescopic image, and a waste of valuable light. Its cause, technically termed the "irrationality" of the spectra of plate and flint glass, may be easily understood by observing that not only is the *whole amount* of dispersion into colour different in plate and in flint glass, but their action on different parts of the spectrum is not the same—the plate throwing the more luminous central rays of the spectrum nearer to one of its ends, the flint nearer to the other. Hence, it is impossible to neutralize the whole spectrum by lenses of two kinds of glass. If we unite the extremities, the central rays will go on one side, and be "outstanding" in focus; if we correct the colours nearer the centre, the extremities will not balance each other. The great art, therefore, of the optician is to neutralize the most vivid and predominant tints; he can do no more; the rest must take their chance. There is, however, some dis-

cretionary latitude, and a choice of evils, and different makers do not prefer the same mode of correction. Glasses which are technically said to be "over-corrected for colour," are generally thought the best. In these, the dark-blue rays which, from their great refrangibility, naturally fall short of the general focus, are projected beyond it by the concave flint, and consequently form an external fringe to the image, which, from their loss, is slightly tinged with the complimentary reddish-yellow;* but this over-correction may be carried too far, producing a needless excess of blue, as is said to be the case with the Munich object-glasses. Sir John Herschel has said, that the whitest pencil is produced by uniting the brighter red bordering on orange, and the most vivid blue, where it begins to pass into green. Glasses thus corrected show a purple or lilac fringe round a white object within the focus, and a green one without it, and "to go beyond this point," he adds, "with the ordinary materials, seems hopeless." In the various forms that we have described, the defect uniformly exists. It may be somewhat reduced in more than one way: in the triple achromatic (and by parity of reason it might be so in the dialyte) by employing a third kind of glass, called Savoy plate; in the peculiar form of double object-glass, proposed by Gauss, and modified by Steinheil (INTELLECTUAL OBSERVER, iii. 148), by means of a slight separation of the plate and flint lenses: Barlow had hoped to remove it in his construction, but was disappointed; quadruple object-glasses have been produced by Steinheil, of Munich, and Grubb, of Dublin,† in which it is reduced, but with a serious loss of light by reflection, unless the inner surfaces are cemented together, which is considered objectionable by the best opticians. To one man alone has it been given to devise and accomplish the complete removal of this great defect, and he has never yet received that general acknowledgment of his great ingenuity and skill, which was his unquestioned due. Towards the close of the last century, Dr. Robert Blair, Professor of Practical Astronomy in the University of Edinburgh, carefully investigated the subject, and ascertained the existence of transparent and colourless fluids, whose separate action upon the green ray (which may be considered the standard of deviation) were respectively greater, and less, than that of

* This should be carefully borne in mind in examining the colours of stars. Struve I. found that the higher powers of the Dorpat telescope (532 to 848) gave them a yellowish tinge.

† The observatory at Armagh is provided with one of these instruments of seven inches aperture, with the unusually short focal length of sixty-eight inches, which is probably rendered practicable by the double number of curved surfaces, each, therefore, only half as deep as in the ordinary form. (These are Sir J. Herschel's data, but I am informed that the aperture is really eight inches.)

crown glass, and which, therefore, in conjunction, would produce exactly the same effect with it. In some cases he enclosed the separate fluids in distinct cells; in others, where they would not decompose each other, he mixed them in one cell between two convex crown-glass lenses. The object-glasses thus formed were of such exquisite quality as to correction, that no trace whatever of colour remained; and the mathematical skill of the inventor enabled him so to remove the spherical error (for which purpose, however, a separate glass lens seems to have been requisite with large apertures) that he actually constructed, in 1791, an object-glass of excellent definition, with only about nine inches of focus to *three inches of aperture!* while, with less exaggerated proportions, there was no comparison between the performance of his telescopes under very high powers, and that of the best ordinary achromatics.* Little notice, however, was taken of this beautiful discovery. Dr. Blair's attention was subsequently directed to a still more important object, in which he was equally successful—the preservation, during long voyages, of lime-juice, on which the health of our seamen materially depends; he instructed, however, his son in his processes, and that gentleman publicly announced, in 1827, his intention to commence the regular manufacture of these instruments, if sufficient encouragement could be obtained. To the sole objection which could be raised—namely, on the score of want of permanency—Mr. Blair was able to give a full reply, the object-glasses having remained unchanged for twenty-one years; but I regret to add, that I have never heard of a single telescope being constructed in consequence of this announcement. Let us hope, that since those days we have made some advance in scientific zeal, and, with the wish that something may yet be done to give due effect to this admirable discovery, we will close our lengthened examination of the construction of the Achromatic Telescope.

NEBULA.

28.—In the *Philosophical Transactions* for 1789, Herschel I. describes a star 9 mag. *f δ Geminorum*, 9m. 6s. of R.A., 1° 1′

* It is curious how narrowly this discovery escaped Newton. He says, in one place, that "it did not seem to him impossible for contrary refractions so to correct each other's inequalities, as to make their difference regular; that, for this purpose, he examined what may be done, not only by glasses alone, but more especially by a *complication of divers successive mediums*, as by two or more glasses, or crystals, with water, or some other fluid between them, all which together may perform the office of the object-glass, on whose construction the perfection of the instrument chiefly depends; and that the result of these trials, as well as the results of theory, would probably be given on some future occasion." Yet we find him, after all, acquiescing in the hopelessness of any such improvement upon the old refractor.

more S., as having "a pretty bright milky nebulosity equally dispersed all round it," which he calls "a very remarkable phœnomenon." He numbers it 45 of his IVth Class, *i.e.*, that of *Planetary Nebulæ*. In the earlier catalogue of Herschel II. (1833), where it stands No. 450 (it is 1532 of the General Catalogue), it is termed "a star 8m. exactly in centre of an exactly round bright atmosphere 25″ diam. The star is quite stellar, not a mere nucleus. Another star 8m. distant 100″, and about 85° *n p*, has no such atmosphere. A most remarkable object." The Earl of Rosse calls it "most astonishing," and represents it as a star surrounded at some little distance, rather nearer perhaps on the *np* side, with a bright nebulous ring, within which again is a less luminous area, brightening up as it approaches the star near its centre; leaving, however, a small dark space close to the star on the *f* side. This curious object does not require a large instrument to bring out all its interest. I have seen it formerly, on two occasions, with $3\frac{7}{10}$ inches of aperture, as a small telescopic comet. 1864, Dec. 1, on looking for it with $5\frac{1}{4}$ inches I caught it with about 30, and saw the central star with 65. The haze, I found, bore magnifying well (whence $\mathrm{H}\frac{\mathrm{I}}{3}$ probably gave it its planetary rank); it appeared slightly more extended *s* a little *f*, and with 451 there seemed to be a very feeble trace of a narrow border of greater brightness at the edge in that one direction, something like a cometary envelope. At this time I had so indistinct an idea of what Lord Rosse had seen, that my observation may be fairly considered an independent one.* The most striking thing, however, that I noticed, was the angle of position with the neighbouring $7\frac{1}{2}$ mag. star. This was given by Sm., 1836·22, = 355°, identical with H's angle, 1833, denominated by the quadrant, as was his practice at that time. I had no micrometer or cross wires in the field, but a simultaneous view of *Polaris* with the left eye, and in four eyepieces, gave the line joining the stars an inclination below the pole of about 5°, consequently bringing it out of the *n p* into the *n f* quadrant.

With very little reason, generally speaking, to trust to my own estimates, all the circumstances of this case induced me to feel unusual confidence in my result; and I was much more gratified than surprised when Mr. Knott obliged me with a very full and careful set of measures with his $7\frac{1}{3}$ inch object-glass, the mean of which gave for 1864·97, 100″·2.

* I have since found that Lassell also has figured it much in the same way, but making the bright annulus very feeble on the *p* side, reducing the interior darker area to a narrow ring, and omitting the dark spot close to the star. He says, "The dark circle is very striking, and altogether the object is very beautiful and interesting."

2°·44. It seems then to follow that either the nebula (together with its stellar centre), or its companion star, must have moved very sensibly during the last thirty years; and this conclusion is confirmed by Mr. Knott's reduction of Argelander's intermediate places. It is impossible at present to say which of the two has changed its position, but this will be demonstrated by future measures; and there is a very minute star *p*, forming the apex of a triangle with the others, which, as Mr. Knott has remarked, would form a good point of reference, if it has sufficient brightness for measurement. Since Mr. Huggins's wonderful discovery, we are more prepared to accept the alternative of motion in either; and the nebulosity, if it possesses light enough, will be a most interesting object for the spectroscope. If it were not waste of time to reconcile so rough a guess as mine with the results of admirable micrometric measurement, it might be observed that they would be very closely approximated by allowing for the extra-polar position of *Polaris*, and for a remarkable bias in vision with which I have since become acquainted through the writings of Sir J. Herschel. That eminent philosopher, in discussing some ancient and valuable observations of *Castor* by Bradley and Pound, in which the telescopic position of the components was found to be parallel to the lines joining certain other stars as seen with the naked eye, found that angles thus estimated required a correction for a tendency in the two eyes, when comparing two straight lines, or two parts of the same straight line, *beheld by each separately*, to give them a different position with regard to the vertical. The difference amounted in his own experience to 2° 43′, at which angle lines really parallel would seem to converge upwards, if so viewed, that while both lines are looked at simultaneously, each eye sees only the one opposite to itself. The experiment is easily tried with any kind of thin screen edgeways in front of the face, but requires a little care in manipulation; for if the eye is very unequally distant from the opposite extremities of the parallel lines, the deviation will be reversed; nor have I been able to bend a horizontal line in the middle, as described by Herschel, till it is placed in an oblique position. The following simple mode of conducting the experiment, I have found effectual. Take a large thin book, the thinner the better, provided it can support itself without being opened, and set it on end upon a table. On each side of it, pretty close to it, but not touching, lay a sheet of white paper on the table, with a weight on it, so that it may not easily be displaced; then rest the nose on the top of the book, when, of course, only one sheet will be visible to either eye. While using both eyes arrange the sheets carefully, so that their nearest edges shall be as sensibly parallel

as may be; remove the book, without disturbing them, and they will be found very perceptibly convergent; replace the book, and the nose upon it, and they will appear parallel as before. This peculiarity, which Herschel tells us was observed by Bessel also, may perhaps give us a hint for the improvement of stereoscopic vision. It seems probable that if the two pictures were so arranged that their sides were not precisely parallel, their coincidence would be more ready, and the illusion in proportion more complete.

I have since observed (having had my attention drawn to it by some of my correspondents) that with low powers there seems to be a minute nebulous star or speck nearly *s* of the nucleus, about 15″ or 20″ distant, which high magnifiers show as a patch of light; a denser portion apparently of the external ring, between which and the nucleus the haze is less luminous. Mr. Knott has remarked that Sm. has measured from the nebulous star, as if it had been the brighter of the two, which it certainly is not at present.

To find this pair (for as such they are treated in the Bedford Catalogue) we must first get *δ Geminorum*, which is the first conspicuous star in a line from *Pollux* towards the Great Nebula in *Orion*. If we then know, as we ought to do, the dimensions of the field of the finder, there will be little difficulty in turning it to a point 1° S. and rather more than 2° E. of the star, when the nebula will be in the field of a low power. Its place for 1860·0 is R.A. 7 h. 20m. 54·4s.—D.N. 21° 11′ 26·8″.

(Addendum.) Since describing in our last number, the Planetary Nebula 39 ♅ IV., I have found that Lord Rosse's 6-foot speculum shows it as an annulus with a wisp projecting into the interior, and faint fringes all round its edge. He figures the two minute stars, but takes no notice of the larger one belonging to the cluster 46 M., which I still see as I saw it last year, and which appears to have been seen by H. at the Cape.

DOUBLE STARS.

Before the season passes we may add two more pairs to our list.

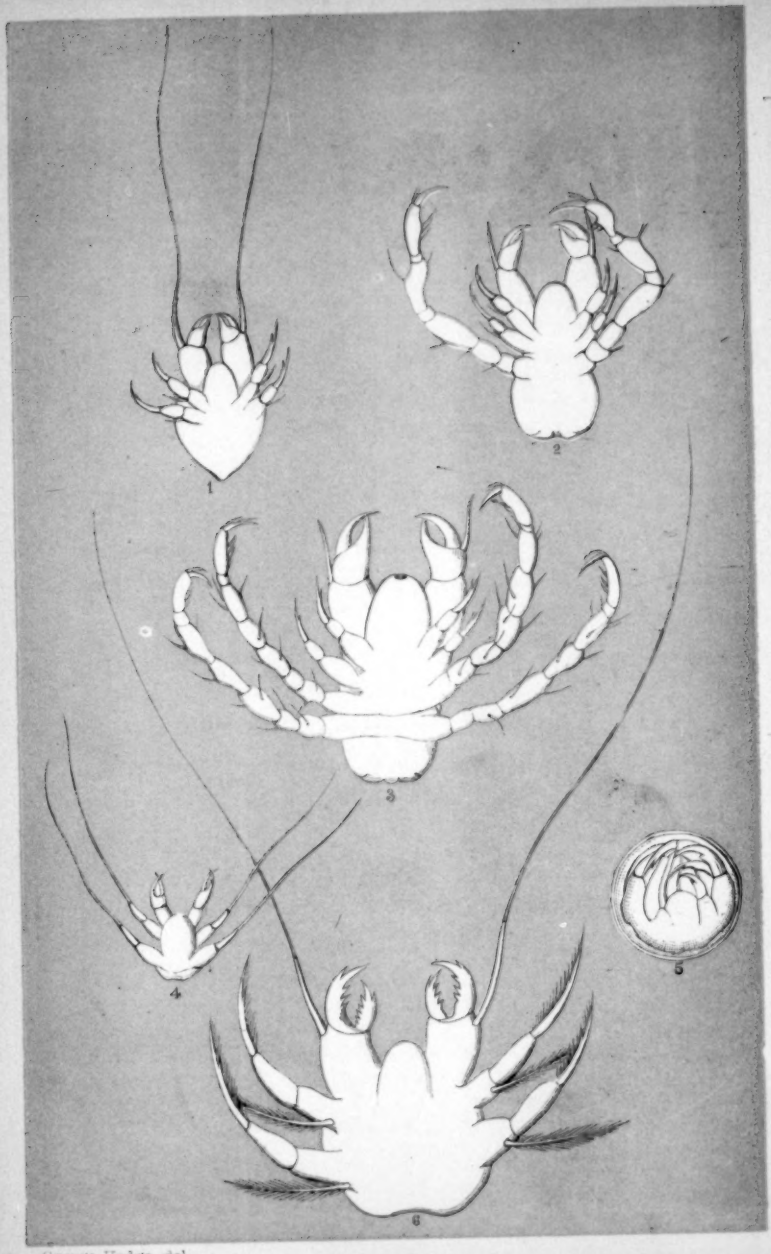
133. *δ Geminorum*. 7″·2. 196°·8. 3½ and 9. Pale white and purple. Stationary, according to Sm., 1838·92. Secchi, however, thinks the angle increases, having been 184°·15 in 1781, and found by him 200°, 1856·107. Both with my former and present telescope I have thought the large star pale yellow. The companion also has appeared to me, with both, very small for 9 mag.—smaller than the attendant of

Castor, rated 11 mag. by Sm. Secchi, likewise, makes the former 8, the latter 7 mag.—equal to about $8\frac{1}{2}$ and $7\frac{1}{2}$ of Sm. The mode of finding δ has just been given.

134. 38 *Geminorum*. 5″·8. 170°·7. $5\frac{1}{2}$ and 8. Light yellow and purple (1839·17). This pair Sm. considered as probably in motion, with a very slow period, which may be upwards of 2000 years. Its binary character has been confirmed by Secchi, who gives, for 1856·112, 6″·137 and 169°·18, to be compared with Σ's 5″·736 and 174°·88, 1829·24, and $\frac{11}{3}$'s 179°·9 in 1783. This beautiful object is pointed at by a line drawn from *Procyon* through its *np comes* β *Can. Min.*, but it must be bent towards the S.; or it may be found by a line from *Pollux* to *Bellatrix* (γ *Orionis*), which points out γ *Geminorum* (3 mag.) in mid-distance; a little *f*, but more *s*, from this star we find a wide pair, ξ^1, 5 mag., and ξ^2, 4 mag., about 2° *f* from which lies 38.

OCCULTATIONS.

April 5. ω Leonis, 6 mag., 11h. 53m. to 12h. 43m. (For a notice of this remarkable star, see INTELLECTUAL OBSERVER, iv. 352. The present will not be an unfavourable opportunity for the observation.)—6th. 16 Sextantis, 6 mag., 8h. 7m. to 8h. 14m. —12th. 3 occultations: 5 Libræ, 6 mag., 7h. 50m. to 8h. 51m.; 8 Libræ, 6 mag., 10h. 40m. to 11h. 52m.; a^2 Libræ, $2\frac{1}{2}$ mag., 10h. 51m. to 11h. 59m.—28th. 120 Tauri, 6 mag., 7h. 59m. to 8h. 53m.—30th. 68 Geminorum, $5\frac{1}{2}$ mag., 11h. 48m. to 12h. 6m.



George Hodge, del.

PYCNOGONS.

ON THE DEVELOPMENT OF THE PYCNOGONS.

BY GEORGE HODGE.

(With a Tinted Plate.)

In a former part of the INTELLECTUAL OBSERVER,* the leading characters of the Pycnogonoidea were briefly glanced at, in such a manner as to serve as an introduction to the study of these animals.

Observations extending over several years, with admirable opportunities of obtaining a plentiful supply of specimens, have enabled the writer to gather somewhat into form certain vague and conflicting notions regarding them—more particularly with reference to their development.

Few observers have made the development of these animals their study; and in most cases, if not in all, investigation has been directed to the earliest stages of the larvæ, owing in a great measure to the extreme difficulty experienced in pursuing the subject further—all attempts to rear the larval forms having failed.

Developmental studies of the lower forms of life are mostly fitful and uncertain—a fact here, another there, gradually builds up the framework we desire, and enables us to link the whole together. Frequently we may have to wait a year, or even longer, to confirm a single observation, and when this delay is experienced in cases where abundance of material can be obtained, it will readily be conceded, that in the case of rare animals, the progress cannot fail to be slow. This is especially the case with the Pycnogons, for with the exception of the littoral species, few of our marine animals are more difficult to procure. They can only be obtained in a suitable state for developmental studies, by the expenditure of much time, and with considerable personal discomfort. The dredge must be kept going on every possible occasion, to afford a supply of living specimens—and it is the dredger alone who knows the discomfort and uncertainty of this pursuit.

The generative function in the Pycnogonoidea still continues a profound mystery, with every likelihood of remaining so. It is one of those secrets which defy solution. Not a trace of an internal ovary has been detected; neither is there any difference in the form of the male, as compared with the female—so far as has been made out to the present time—further than the well-known "false feet" or "egg-carriers," which in certain genera are only possessed by the so-called

* July, 1863, Part xviii.

females, whilst in others (according to Kröyer) both males and females possess them.

These false feet, or egg-carriers (for no other office has been assigned to them), are jointed limbs, produced from the anterior portion of the thorax, between the origin of the rostrum and the first pair of legs; the number of joints of which they are composed varies in different genera, and affords a generic character in the case of *Pallene* and *Phoxichilidium*: the former having nine or ten joints, and the latter only five. The *ova*, which are found in masses of a globular form, to the number of two or three, are attached to these limbs; the limb usually passing through the centre of the globular mass. At the earliest stage at which the ova has been examined, they are merely little granular bodies, each the $\frac{1}{500}$th of an inch in diameter, or thereabouts, according to the relative size of the species producing them.

The "oviferous mass" is composed of a large number of these ova, and invested by a tough skin, which nevertheless admits of extension during the enlargement of the granules. It seems highly probable that the earliest stage of this mass is a single germ, which undergoes segmentation, and resolves itself into a number of independent ova. This view is suggested by the fact that in early stages the oviferous mass is a hard ball, consisting of a number of closely compressed ova, which by degrees assume a globular form, and then separate from each other; and further than this, each ovum is attached by two or more filaments to the skin, which invests the whole, proving that it has a close and intimate connection therewith. But how this oviferous mass becomes attached to the false feet or "egg-carriers," no one has been able to discover, nor even surmise. The development of these animals in their earliest stage is consequently involved in obscurity.

Various observers have recorded the result of their observations respecting the earliest stage of several species. Kröyer has, however, done more than any one else, for he figures several stages;* whereas other writers have merely recorded their observations on the stage immediately after quitting the egg.

I have only been fortunate enough to trace out the entire development of two species (*Phoxichilidium coccineum* and a species of Nymphon); but they present such totally different results that neither can be taken as a type of the development of the order, and it seems highly probable that each genus will be found to vary considerably from those associated with it.

* Sur les Metamorphoses des Pycnogonoides. Par M. Kröyer. *Ann. des Sciences Naturelles*, 1842. M. Kroyer in *Gaimard's Voyages en Scandinavia.*

The writer has already published his observations on the development of *Phoxichilidium coccineum*.* It may not, however, be altogether supererogatory to briefly reproduce some of the circumstances attending the singular metamorphoses of this animal, as it is principally the object of the present paper to present a *resumé* of the state of our knowledge respecting the development of these animals.

This species is common on our rocks at extreme low water, and is doubtless familiar to most persons conversant with our littoral fauna. During the winter and early spring months the females are found with large oviferous masses attached to their false feet, which in course of time produce curiously formed larvæ (see Fig. 4). They are of a rounded form, and possess two pairs of legs, a pair of foot-jaws, and a rostrum; they retain this form for a few days, and are usually attached to the oviferous mass by four long filaments, *which proceed from the tips of the legs*. The connection does not, however, last long, for the little beings soon enter upon a free and independent existence, during which they must moult, for on again meeting with them, they present a very different aspect. Now comes the singular portion of their life history, which to understand requires us to be somewhat acquainted with a totally different animal.

During the spring and early summer months the rocks begin to furnish their annual growth of Algæ and Zoophytes. Conspicuous amongst the latter, on the Durham coast, is a very elegant little Hydroid Zoophyte, *Coryne eximia*, which, for the information of those not conversant with this order of animals, may be described as a tiny shrub of a horny nature, bearing club-shaped polypes at the termination of each branch. These polypes are produced by the gradual accumulation and growth of the fleshy and chitinous substances of the polypary. At first a mere short rounded stem, the terminal part being less dense than the stem, an accumulation of organized material takes place, which in due course developes into a polype. Whilst examining some stems of this Zoophyte I noticed that there were a number of sacs attached to the stems, which, although a part of the polypary, were nevertheless different to any growth or part of the animal. On being opened, these sacs were each found to contain a curious little animal of a bright red colour. The subject was followed up, and it was shortly afterwards proved that the animal in question was a stage in the development of *Phoxichilidium coccineum*, in advance of the larval forms observed immediately after escaping from the egg. Other stages were found (still within the Coryne), showing further advancement, until

* *Annals and Magazine of Natural History*. January, 1862.

finally the egg was traced to the mature animal, disclosing a very singular and unexpected mode of development; for the question at once arises, How do the larvæ gain access to the Zoophyte?

The development of *Pallene*, a genus which in some respects resembles *Phoxichilidium*, varies from that described in certain important respects. The writer has only had an opportunity of examining one of the larval stages in a specimen of *Pallene brevirostris*, the observations being unfortunately brought to a somewhat hasty termination—the specimen being accidentally destroyed. It was, however, observed that the young in a far advanced stage were attached to the false feet of the female, in what manner could not be made out, owing to minute size, and being very much crowded. They possessed foot-jaws, a rostrum, and three pairs of legs, *all of similar form to those of the adult animal;* proving that the young remain attached to the parent up to a late period of their development, and perfect the growth of their limbs—or most of them—whilst so attached, in such a manner as leads one to suspect the development of the genus must be upon a plan altogether distinct from others examined.

In *Nymphon* the development takes a much simpler and more easily understood plan. Several species have been examined in their earliest or larval stage, at which time the young animal is about the $\frac{1}{100}$th of an inch in length, and scarcely so broad. It possesses two pairs of feet, which are three jointed, the last joint being elongated and in the form of a claw; a rostrum and a pair of foot-jaws of large size, which are quite out of proportion to the remainder of the animal: the nippers are strong, the moveable finger usually overlapping the other.

A stout spine-like appendage is produced from the summit of the first joint of each foot-jaw; from the outside proceeds a long slender filament, by which the larva is attached to the oviferous mass for a short period after its birth: being of an active habit, it soon frees itself, and is then carried about by the motion of the water until it finds a lodgment amongst the stems of Zoophytes or the like, where it receives food and shelter. Doubtless, large numbers are carried about by the currents of the sea and perish, for although all of the Pycnogons are decidedly prolific, and each individual carrying ova, must produce many hundred larvæ in a season, the mature individuals are unquestionably rather rare. Mature Nymphons are usually obtained amongst Zoophytes from deep water, but appear to be very rare between tide-marks; it is, therefore, singular that the stage in advance of the larval ova, just described, should only have been found nestling amongst the

stems of *Bugula plumosa*, a littoral Zoophyte on the Durham coast—although various Zoophytes from deep water have been subjected to the most careful scrutiny. Several curious little animals were found on this Zoophyte a few years ago, at a time when the early stages of the Pycnogons were unknown to the writer; they proved a complete puzzle until earlier and later stages were found, when an insight into their probable character was gained, and extended observations on the development of these animals clearly established the early life of Nymphon.

A reference to the plate accompanying this will enable the reader to understand the further changes which take place. It will be observed that the posterior portion of the body is obtusely rounded, this gradually changes, until at last a slight notch appears on each side, which becoming more decided presents the appearance of three narrow lobes. These separate from each other, those on each side gradually elongating and developing into legs; whilst the centre one, increasing in width, pushes out the newly formed limbs in a lateral direction. The joints are then visible, at first close to each other; but by degrees they increase in length, after which the claws on the terminal joint appear. The hairs are also produced, and the little animal presents a most grotesque appearance (see Fig. 2). The posterior portion, meanwhile, continues to elongate, and going through the process just described, a second pair of legs is the result; again it repeats the operation, when a third pair is produced. The young animal now closely resembles a Pycnogon, excepting the presence of the anterior rudimentary limbs and the large spine on each foot-jaw; if it were rid of these, it might readily pass for a young Pycnogon about to produce its fourth and last pair of legs. We accordingly find that these rudimentary limbs, having served the requirements of the larval stage, are now no longer needed, and are readily got rid of by a moult, which takes place at this stage, the fourth pair of legs being usually produced at the same time. Having neither palpi nor false feet it is of course far from perfect, and might be either a *Nymphon*, a *Pallene*, or a *Phoxichilidium*, for what we could tell. These important organs are afterwards produced, the palpi being the first of the two to appear. Near the base of the foot-jaws a wart appears, which gradually elongates and developes into these well-known and characteristic parts. The false feet are produced in a similar manner, from a wart growing near the origin of the first pair of legs, and on the full growth of palpi and false feet the animal attains maturity.*

* See figure in INTELLECTUAL OBSERVER, 1863, p. 416, fig. 2.

The larvæ of Pycnogonum, Achelia and Zetes, resemble the species just described in their general contour, although, as might be expected, there are certain characteristic differences. They all possess foot-jaws similar to those described, from which are produced the filamentary appendages as in Nymphon. These organs in all the species examined are kept constantly in motion—a sort of "whipping action," which it seems probable may assist in impelling the little animal through the water. The presence of foot-jaws in the larvæ of these genera is a very singular circumstance, for the mature animals are quite destitute of them. Excepting, therefore, for the fact of having obtained the mature animal with the larvæ attached, one might reasonably be disposed to question the possibility of the immature animal being in apparent advance of its parent in certain respects, for foot-jaws are undoubtedly a type of elevation.

Much has yet to be learnt respecting the development of these animals, and so far as one can judge from analogy, all must undergo some singular metamorphosis between the two stages known, the earliest and the mature. Those observers who have opportunities of obtaining living specimens would do well to endeavour to make out the development of *Pycnogonum littorale*, as it seems highly probable it will prove quite distinct from those just described. Hitherto it has eluded the writer, possibly some one else might be more fortunate.

EXPLANATION OF THE FIGURES.

Fig. 1. Larva of *Nymphon*, as attached to parent (magnified). 2. Second stage of the same animal, ditto. 3. Third stage of the same, ditto. 4. Larva of *Phoxichilidium coccineum* as attached to parent (magnified). 5. Embryo of *Pycnogonum littorale*, ditto. 6. Larva of *Pycnogonum littorale*, ditto. (All represent the under surface, to show origin of rudimentary limbs.)

NOTE ON AN ARTICLE ENTITLED "LIFE CONDITIONS IN OTHER WORLDS."

CONTAINED IN THE "INTELLECTUAL OBSERVER" FOR MARCH, 1865.

BY GEORGE E. ROBERTS, F.G.S., HON. SEC. A.S.L.

WE are familiar with many subjects said to be, in the common parlance of the day, of "world-wide import," but it so rarely happens that an inquiry is introduced in a liberal philosophical spirit, which soars beyond our mundane economy, that it appears to me highly desirable that the subject upon which I offer a "Note," one illustrated by so many cautiously-chosen facts and excellent suggestions, should not at once be lost sight of amid the crowd of natural history papers which enrich the INTELLECTUAL OBSERVER. We have been so much accustomed to limit the cause, or the extension, or the working of a natural law to the earth and its surrounding atmosphere, when reasoning upon geological or biological subjects, that many of our theories, derived from such a limited reading of the book of nature, have had to be abandoned, and others modified as the area traversed by our intellectual perception became more extended. And now that it may reasonably be surmised that no element in the physical construction of the earth, or law which governs it, is confined either in existence or operation to our globe, it becomes more than ever certain that many of our conclusions and deductions will have to be re-examined under the light of a broader philosophy, and more than ever imperative that the utmost caution should be exercised in propounding any theory. If, as it appears most probable, this world and all it containeth of animate life is to be expressed merely in mathematical formulæ, as a term of a connected series, which, varying in value each from the other, together make up the perfected scheme, it will assuredly lead to a more large-minded method of studying the higher and more complex branches of natural research, and give a better moral tone to the work.

Studies in comparative natural philosophy, as *e. g.* between the earth's atmosphere, chemically or otherwise, and that of Mars or Jupiter, will be more extensively made; and who can say how many remarkable relationships with, or divergences from, the standard we have until lately set up from examination of the earth alone, as one common to the universe, may not be discovered? And although we may never by any means of research make out with certainty the actual existence of life on any one of the planets, yet after discovering the conditions which they may possess favourable for its existence, we shall

be less puzzled in our endeavour, hitherto so fruitless, to make up the palæontological and zoological record of life, extinct and existant, upon the earth's surface; and hemitypic birds, reptilian fish, creatures retaining through life rudimentary limbs or organs, or embryonal characters, may appear as significant of orders of life existant in other worlds, perhaps in a more typical or perfected form. We shall not be the less wise if we are thus compelled to study the fauna and flora of the earth as a fragment of a scheme of life, in which, may-be, much is but shadowed to us, and some elements concealed altogether. If increase of such knowledge as the author of the paper suggests will lessen our dependence on schemes drawn from objects ocularly or tangible before us, it will surely aid our faith in the wisdom and beneficence of the Creator.

AIDS TO MICROSCOPIC INQUIRY.—No. V.

Simple Forms of Life.

We do not propose to publish this series of papers in the order in which they would be most logically arranged, as a less regular method will afford more variety, and enable us more quickly to meet the wishes of subscribers requiring different kinds of information. We shall, therefore, postpone the further consideration of certain points of physical science essential to microscopists, and devote our present attention to Simple Forms of Life. We will suppose a collection of ordinary objects obtained from a pond or clean ditch, by bringing home weeds as well as water, and that the student has thus before him specimens of animals and vegetables the characters of which will be more or less definite and distinct. The first question a young microscopist puts is, "How am I to know animalcules from plants?" and, although the query may appear easy of solution, the establishment of fixed lines of demarcation not only remains a permanent difficulty, but at last a modification of the old notion of zoophytes, or animal-plants, is actually revived, although, by no means including the objects for which the designation was originally employed, nor suggesting the precise ideas which the older naturalists entertained. If we were to say that the simplest form of life consists of a single *cell*, we must so far modify that term as to make it comprehend a globule or molecule, in which there is no special distinction of *cell wall* and *cell contents*. Properly

speaking, a *cell* is a chamber of some sort enclosed on all sides, and physiologists employed it to designate a little chamber, or space, enclosed by a membrane or tissue, and holding inside it living matter. It is not necessary that we should explain the details of cellular physiology as it was laid down a few years since, as scientific men have pretty well agreed that it must be greatly modified, and it is impossible to avoid recognizing the fact that the functions of life may be performed by little globules or molecules of appropriate matter, which are not surrounded by any distinct membrane or wall. It is, however, probable that the smallest living object consists of matter in at least two states, and if from no other cause than the influence of position, the outside layer will differ more or less from the inner portions.* It might appear difficult to conceive of a simpler animal than an amœba, but a high power shows that the gelatinous material, or sarcode, of which it is composed contains a number of spherical molecules or granules, and any one of them, if isolated and capable of sustaining its life, might, perhaps, represent what, if we adopt the cellular nomenclature, might be called a unicellular creature.

The amœba, in its simplest state, is an illustration of life, with predatory habits and considerable activity, carried on without the help of positive organs. Former numbers of the Intellectual Observer have described the villous projection, discovered by Dr. Wallich, in certain forms of this creature, and it also possesses an apparatus for reproduction, as he has shown. We may, however, regard all its ordinary proceedings as carried on without the aid of distinct organs, although the various globules it contains, and which present no distinctive character to the eye, may still have separate functions to perform. Young microscopists are pretty sure to pass over small delicate amœbæ without notice, and it is a mere chance whether they happen to turn upon large easily-noticeable forms. If they have any more experienced friends to help them, they should see an object of this kind as early as they can, as some conception of its appearance and ways is very desirable at the commencement of a study of organic beings. We see a mass of jelly moving by the faculty of thrusting out portions of its substance into projections termed *pseudopodia*, or false feet. Out goes, or rather *flows*, a dribble of the jelly, extending into prolongations longer and thinner, or thicker and broader, according to the particular specimen under notice. The outside layer (which may soon become the

* See a former article, Vol. vi. p. 75. The last sentence, page 79, is especially applicable.

inside) gets on first, and sticks to the glass slide on which we view it, then comes the rest of the creature, globules and granules, flowing and rolling over each other, until the point of vantage gained by the false foot is reached by the mass. Now another false foot is thrown out, and the same plan repeated. If a suitable morsel of food comes in its way—and it seems very fond of coloured monads, which often give it the appearance of having dined on glittering gems—it opens a cavity, sucks the article in, and the hole closes up, leaving no trace that any solution of continuity has occurred. Though it has neither mouth nor stomach, it exhibits full animal characteristics. It lives upon organic matter already prepared, while a typical plant absorbs inorganic matter and organizes it for itself. Though it has no nerves, it must have some sort of sensitiveness, as it knows when to open a cavity in its flesh and what to swallow in, and we also notice a capacity of adapting itself to the circumstances it meets in its somewhat slow and limited journeys; thus, if it encounters an obstacle, it does not persist in trying to force through it, though it will squeeze through a narrow gap, nor does it merely bound back in a mechanical way. It appears therefore to have volition of a humble sort. Here then we see that a few molecules of a *protein* substance* connected together under that species of partnership and co-operation which is implied by the term *life*, are able to do most of the acts essential to the mere existence of higher kinds of animals.

We shall not now anticipate remarks that will come appropriately in subsequent papers, but we may observe that matter in the condition of the flesh or sarcode of the amœba not only reappears in other groups of animals, some of which, like the *Foraminifera* and *Polycystina*, form exquisite shells of lime or flint, while others build up the fabric of sponges, the harder portions of which act as supports for the soft lining material; but we find something like it in the highest kinds of being, and, paradoxical as it may appear, there is reason to suppose that if we ourselves did not lead the lives of amœbæ, we should not be able to lead the lives of men. Dr. Bowerbank has the merit of pointing out the persistence of the sarcode system throughout the animal world. He says, "As we descend in the organic scale of life, we find the great systems of animal functions, the osseous, the muscular, the nervous, the sanguineous, all becoming simplified, until at last one or more of them is found entirely wanting. But the sarcodous digestive system appears never to be absent, we find it, from the highest organized mammals, in the form of the

* A substance chemically resembling that which composes the tissues of higher animals.

mucous lining of the alimentary organs, passing through animals of every degree of development, until the animal itself becomes simplified to the degree of appearing as a mass of gelatinous sarcode only, or with possibly a central nucleus of membrane, as in *Actinophrys sol*," etc.

The animalcules which the beginner will find in his collections are all composed of sarcode, and the differences to be observed amongst them concern first the degree to which a distinct integument exists, and secondly the character of the organs or parts that can be seen in all but the most elementary and minute kinds.

We shall have occasion to recur again to the animal series, but it will be convenient to take a preliminary glance at some simpler vegetable forms, and although the beginner in collecting objects for the microscope is very likely to pass over the amœbæ he may acquire, he is sure to see plenty of quite a different object, the euglena, a lively little green fish-like thing that abounds in the green scum of ponds. When he sees this creature swim rapidly hither and thither, lashing about the filament which springs from its head and constitutes its organ of locomotion, when he further beholds it change its shape, now taper and spindle, now squat and pear-like, now round, and so forth, who can doubt that a veritable animal is in view? Not so; the euglena is merely a plant, and further inquiry will show that it is not uncommon for simple plants, or for their spores, to possess cilia, and exhibit what is easily taken for voluntary motion.

The possession of a cilium, of which a vibratile filament may be taken as a modification, gives no clue to the animality or vegetality of the object employing it. A cilium may be an organ of voluntary or involuntary motion. We find it continually moving, through mere physical stimulus, in creatures of both high and low organization, or, as in the tentacles of a rotifer like Stephanoceros, evidently under the command of a will directed by a noticeable amount of intelligence.

When a swarm of euglenæ and other infusoria move quickly through the field of the microscope, we have a (relatively) powerful lashing of whips and twirling of cilia, without a single muscle to do the work. Thus the contemplation of a few simple microscopic forms has introduced us to locomotion without limbs (as in the amœba), sensation (of some kind) without nerves, ingestion of food without a mouth, digestion without a stomach, and active exertion, with motion of appendages, without a muscle to do the work. It is like the German story, in which the blind man shoots a hare, a lame one runs after it, and a naked one puts it in his pocket.*

* Kinder und Hausmärchen "Knoist un sine dre Sühne."

It is no part of the intention of these papers to act as a substitute for works of microscopic natural history, to which the reader must be referred when he wishes to discover the name of any particular object, but we shall make some general remarks that may facilitate his search. A simply organized body is likely to be a plant when it contains a substance like chlorophyll, or green sap, or when it is brown, or red, of the tints well known in leaves. Of course the distinction must be made between the chlorophyll matter properly belonging to an organism, and that which may have been swallowed by it. The possession of cilia or whips does not decide animality or vegetality, but moveable styles, hooks, etc., characterize some of the higher animalcules. Red spots looking like eyes are no evidence of animality. The euglenæ possess them, and they can only be distinguished from true red eyes, as may exist in rotifers, by the use of high powers, which shows whether an optical structure really exists.

In studying simple vegetable forms, no object is more accessible than the green slimy stuff that grows on damp stones. A little piece should be scraped off and placed in a drop of water, on a slide, covered with thin glass and gently pressed. It is then ready for view, and is seen to be composed of oval or rounded patches of green matter, enclosed in a gelatinous envelope. The multiplication of these patches takes place by division of the cells. First the cell contents take an hour-glass form, then a constriction appears, finally a division, each half finishing itself off, secreting more of the gelatinous casing, and being ready to split again as before. Sometimes two cells will join and fuse together, with a certain mingling of contents. This is called *conjugation*, and from it a spore results, and that in its turn gives rise to a new individual, which by the mode of fission just described soon produces a fresh generation. In damp weather this plant, the *Palmoglœa macrococca*, and many other objects more or less resembling it, multiply with great rapidity by the method of division; a little more warmth and dryness promotes the conjugation, and checks the fission. This is somewhat analogous to what takes place with the *aphides*, or plant lice, which multiply by an internal method analogous to vegetable budding, while the circumstances favour their rapid growth, and start a fresh generation by the united action of males and females, when the means of subsistence, and the temperature, are less plentiful and propitious.

A great many simple vegetables exist during a portion of their lives, or in one of their stages, in a motile form, and many little objects taken by early observers for animalcules are plants in this condition. This is the case with the euglenæ,

which may be easily observed in their resting stage. Many plants emit spores that swim freely for a time (zoospores), and others form in little receptacles *antherozoids*, which swim and meet another class of cells, the fertilization of which they effect, somewhat as the pollen, borne on true anthers, acts upon the germs of higher plants.

The entire life history of the lower forms of animals and vegetables is very incompletely known. In a few cases a complete cycle of changes has been traced out, but it is probable that a great number of objects to which specific names are given, are not in themselves complete in their kind, but only early forms of more complicated organisms.

A student is always surprised to find that a great many adult forms have lost faculties or organs that might have been expected to remain. Thus locomotion seems an attribute of dignity, and the loss of the power might be taken as an indication of retrogression; but in many of the lower vegetables, and in many animals also, the locomotive stage is that of infancy, while the adult approaches more to the Buddhist idea of perfection, and enjoys repose. That which should elicit attention is the relation between the structure and attributes of any object, in any stage from that of the egg to maturity, and the observer should watch the work it has to perform for the perpetuation of its own species, and its defence against foes. In both the animal and the vegetable worlds we notice cases in which the infant form must either perish or be able to take care of itself, while in others it may be safely left to depend upon maternal aid. Nature supplies an infinite variety of conditions in which life is possible, and a corresponding variety of living beings capable of thriving under circumstances having the right relation to their structure and ways. As Darwin has shown, those best fitted for their conditions thrive, those least fitted pass away; but such is the harmony of the entire system, that no group can perform its own duties without benefiting others. And in the microscopic world of life we see the interdependence of different sorts of beings displayed conspicuously on a scale which is extremely small if we contemplate only the spectacle afforded in our slides and preparations, but which is enormously large in nature, inasmuch as no process of growth or decay occurs on the surface of the globe without minute organisms contributing towards, or even determining the result.

In the protoplasm of the plant, and in that similar substance the sarcode of the animal, as we can see it through the microscope in the simpler organic forms, we may trace actions that lie at the foundation of all terrestrial life. In the lower kinds a few actions are co-ordinated and combined for a simple

result, in the highest the number of such combined actions is incalculable, the variety great; so if we look to human society, savage existence co-ordinates little and accomplishes little, while civilization grows in proportion as it multiplies the number of actions that conduce to a given end, and exhibits the greatest quantity of individual diversity harmoniously directed to secure the welfare of each in the advantage of all.

NATURALISTS' FIELD CLUBS; THEIR WORK AND WAYS OF DOING IT.

BY GEORGE S. BRADY, M.R.C.S.,

Secretary to the Tyneside Naturalists' Field Club.

Now that naturalists' field clubs have become so numerous and so widely popular, it may be useful to devote a few pages to the consideration of the manner in which they are usually conducted, and the ends which they chiefly aim to promote. Their capacity of usefulness is perhaps greater than at first sight might be imagined; and it will be matter of regret if the opportunities within their grasp are not turned to the best account. Possibly the present widely spread interest in them may prove to be, like other popular hobbies, somewhat evanescent; at all events, it is prudent to act on the maxim, "Make hay while the sun shines."

The first-established of field clubs was the Berwickshire, which began operations in 1831, and owed its formation mainly to the zeal and energy of the late Dr. George Johnston, of Berwick. In 1846 the Tyneside and the Cotteswold clubs were instituted, and since that time a large number of clubs—mostly flourishing associations—have been formed in various parts of the country. The following table exhibits the dates of formation, numbers, and rates of subscription of some of the more important:—

	Date of Formation	Annual Subscription.	Entrance.	Number of Members (1864).
		s. d.	*s. d.*	
Berwickshire Naturalists' Field Club	1831	6 0	...	206
Tyneside " "	1846	5 0	5 0	522
Cotteswold " "	1846	10 0	21 0	94
Warwickshire " "	1854	about 3s 6d	...	93
Manchester Field Naturalists' Society	1860	10 6	10 6	about 500
Liverpool Naturalists' Field Club .	1860	5 0	...	633
Bristol Naturalists' Society . .	1862	5 0	...	195

It may be noted that the Manchester and Liverpool clubs include amongst their members a large proportion of ladies. There is considerable variety in the modes of procedure adopted by the different societies, but an essential feature of all of them is the holding of "field meetings" in their respective districts during the summer and autumn. In most cases the excursions are made to occupy the entire day; in others, chiefly those where there is a profusion of the fair sex, the afternoon only is usually devoted to the excursion. In these cases, too, the general arrangements seem to be devised very gallantly with reference to the lady constituents, even to the measurement of the stiles on the line of march; for in one of the Liverpool club's circulars for last season I find "the minimum stile guage" stated at *one foot*—a discouraging announcement, one would think. In some cases the practice exists of offering prizes for the best collections of plants obtained during the day's ramble. For my own part, I can see nothing to commend in this system. Indeed, in the case of rare plants existing only on a very limited area, one can scarcely imagine a better device to ensure their speedy destruction. During a recent visit to Manchester, I learnt that such a result had actually been brought about, to some extent, in that neighbourhood.* Moreover, this prize system is not very likely to promote the good of science in any way. The study of nature ought to be, and is, to every real student, its own reward; and such a one will scarcely be found condescending to a competition of this kind.

Very few of the field clubs—indeed, so far as I know, none except the Berwickshire and the Tyneside—attempt the publication of "Transactions" on a more ambitious plan than the simple reporting of their meetings. It is, however, very much to be desired that they should generally make an effort to publish carefully prepared catalogues of the different natural productions of their respective districts. This has, to a limited extent, been accomplished by some clubs, and is one of the most useful directions in which surplus funds can be employed. Local floras, at any rate, might mostly be compiled; but it should be remembered that the value and interest of these

* Since writing the above I find it stated, in the Annual Report of the Manchester Society, that "it is gratifying to the committee to be assured that no rare plant has suffered through the society;" so that there appears to be a diversity of opinion amongst the members of the society on this question. The committee, however, propose to enrich the natural flora and fauna of the district, and so to "add to the beauty and interest of the country round Manchester, by taking with them on their excursions any surplus roots and seeds they may possess, especially of native plants brought from a distance, and also living fresh-water molluscs, and depositing them in places where they would be likely to become permanently established. . . . Also to enrich the neighbourhood by a judicious sowing of the seeds of exotic plants."

publications would be much enhanced by their embracing something more than a mere record of names and localities. The lithological and climatological distribution of plants, and the altitudes which they attain, are matters which should receive attention. And now that a good pocket barometer is so easily attainable, a more useful and agreeable pursuit than the collection of such data can scarcely be recommended to the excursionist, provided that he is already familiar with the plants themselves.

The recording of meteorological observations is a matter quite within the legitimate range of a field club's operations. There are in most districts many observers who keep regular records of rain-fall, temperature, etc.; and if these observations could be got together, and annually tabulated, the result would in time form a record of very great value. As an offshoot of this system, records might also be kept of the periodical return of the seasons, as indicated by the flowering of plants, arrival and departure of birds, etc. Printed forms adapted for these entries have for several years past been distributed amongst its members by the Tyneside Club; and it is not unreasonable to suppose that the habits of observation thus fostered in those who carefully fill up the forms may lead to still more interesting results in other departments.

Those clubs whose district includes any portion of sea-coast would do well to encourage its exploration by means of the dredge. Near the shore this may very easily be accomplished by private means, but when it is desired to explore the more profound depths at a considerable distance from land, the necessary expenses of the work are such as to be beyond the reach of most naturalists. In these cases the pecuniary aid of the clubs may be most useful; and where the work contemplated is beyond even their means to accomplish, it is quite likely that an application to the British Association (provided a competent managing committee could be named) would not be made in vain. During the last three years considerable dredging operations of this kind have been conducted by the Tyneside Club on the north-eastern coast, and they have been largely assisted by grants from the British Association. Altogether a sum of about £130 has been expended; many new forms of life have been discovered, and much interesting information as to the relations of our deep-sea fauna has been brought together; besides which, the training thus given to those who have taken part in the work has been most valuable, and will probably bear fruit for many years to come.

But besides the direct encouragement of natural history and the cognate sciences, a large sphere of usefulness is open to them in endeavouring to discourage the wanton and useless destruction of natural objects, antiquities, etc. Many evils of

this kind are probably beyond their reach or control; others might possibly, by judicious treatment, be partially or altogether averted. One of the most grievous of these is the constant destruction, by gamekeepers, of birds of prey and other animals, under the notion (often a very mistaken one) that they prey upon game birds or their eggs. That predatory birds, etc., do kill off, to some extent, the weaker species, cannot, we suppose, be disputed, but those which fall victims must generally be the weak, old, or diseased individuals; and it may very well be doubted whether the natural destruction of these would not be a benefit rather than a loss to the game-preserver. Disease amongst grouse used not to be so much heard of before the inauguration of the present system of "*vermin*"-killing. Much might be written upon this part of our subject, but the present is not the place to enter further into it. Whether the various field clubs could, by the distribution of printed appeals to landowners and game-preservers, do anything to stay this gradual extermination of our most interesting *ferœ naturœ*, is a matter well worthy of their consideration. If an intelligent interest in natural history could be communicated to the gamekeepers and their masters, much would be done to stay the havoc. The wholesale destruction of small birds by indiscriminate bird-nesting in the neighbourhood of large villages and towns is another growing evil. In some districts where song-birds used not long ago to be abundant, they are now becoming lamentably scarce. It is needless, here, to dwell upon the destruction thus indirectly caused to trees and crops by the multiplication of insect pests, which should have formed the natural food of the smaller birds. So true is it that not one of nature's arrangements can be broken without causing a wide-spread disorganization. The extermination of rare plants and ferns is perhaps a smaller evil, but still a grievous one; moreover, it is generally brought about by hands more polite than those of gamekeepers and country lads, perhaps even by members of field clubs themselves. It is difficult, too, to speak in very sweeping terms in condemnation of it, for when a man really wants a plant for his herbarium, or a fern for his greenhouse, it is hard to say he may not take it. We would exhort the botanist to be content with the *flower*, and to leave the root; the fern-grower to pause awhile, and think of Wordsworth's beautiful lines—

> "Ere from the mutilated bower I turned
> Exulting, rich beyond the wealth of kings,
> I felt a sense of pain when I beheld
> The silent trees, and saw the intruding sky.
> Then, dearest maiden, move along these shades
> In gentleness of heart; with gentle hand
> Touch—for there is a spirit in the woods."

Yes, kind reader, leave the fern; so, in the aftertime, shall it often in its quiet, unmolested beauty, "flash upon that inward eye which is the bliss of solitude."

There is even some risk of plants once tolerably common becoming rare, owing to the constant depredations of collectors. A very few years ago in far Easedale, an unfrequented glen near Grasmere, the banks of the stream were rich with forests of *Osmunda regalis*. Last autumn I heard that not a plant remained. From the more accessible habitats of Rydal and Grasmere it has long disappeared, though it once fringed the lake with a luxuriant beauty which sent De Quincey into raptures, and drew from Wordsworth a line which the Opium-eater styles "the most beautiful independent line in the whole records of poetry"—

> "Fair ferns and flowers, and chiefly that tall fern,
> So stately, of the Queen Osmunda named;
> Plant lovelier, in its own retired abode
> On Grasmiere's beach, than naiad by the side
> Of Grecian brook, or Lady of the Mere,
> *Sole-sitting by the shores of old romance.*"

OUTLINES OF METEORIC ASTRONOMY.

BY A. S. HERSCHEL, B.A.

(1.) The history of Meteoric Astronomy may be briefly divided into four periods—of Speculation, Observation, Explanation, and Prediction. The first of these periods dates from the time of Aristotle (330 B.C.) to the time of Cornelius Gemma (A.D. 1450). In the absence of any evidence to the contrary, we may suppose the opinions of Aristotle to have prevailed during the whole of the period, and the following summary of his views is derived from the chapter of his works in which he treats of meteorology.

The Principle of Heat, or "Phlogiston," to borrow a word from later chemical writers, must, he says, levitate, or tend upwards, while all other known bodies gravitate towards the earth. Suppose that, by combining with "phlogiston," large quantities of humid and terrestrial vapours have been elevated to the summit of the atmosphere, they will there come into immediate contact with the revolving celestial sphere, and the "phlogiston" being set free by friction they inflame, and the northern-lights are produced. When the vapours are drawn up in a column and kindled at the summit of the atmosphere, a fire-ball is generated, just as a flame runs

down the smoke and gas when a lighted match is approached to the wick of a smouldering taper. Other vapours again are too heavy to be lifted completely to the summit of the atmosphere, which is the native region of heat. The "phlogiston" then escapes upwards, and projects downwards the ponderating vapours, as a cherry-stone is jerked from between the finger and the thumb. These are the shooting-stars. Aristotle regarded aërolites as having been carried up into the air by whirlwinds, and thence let fall. Anaxagoras, on the contrary, believed them to be pieces of the heavenly bodies.

(2.) A century after the time of Cornelius Gemma, whose work illustrates the views of Aristotle, Copernicus and Galileo flourished at the end of the 16th, and Kepler at the beginning of the 17th century. These astronomers combined to raise the science of astronomy to a new point of perfection by their observations, and Kepler was the first to publish an "Ephemerides," or yearly journal of his observations, in one of which there is described a fire-ball that passed over the whole of Austria from east to west with a terrific explosion, on the 17th of November, 1623. On the 31st of March, 1667, a similar detonating fire-ball was observed in Italy, and described by Montanari. A meteor was seen at twilight in England on the 20th of September, 1676, and taken by Wallis to have been a comet. A detonating meteor that visited England on the 19th of March, 1719, was described by Halley, and attributed to the combustible gases imagined by Aristotle. This meteor was, he thought, seventy miles high, and, therefore, at the very summit of the atmosphere, and the great explosions were explained by remarking that they might very well be caused by gas, which often produces in coal mines frightful catastrophes. These meteors he recommended for the future to be carefully observed, in order thereby to determine the longitudes of distant places. These recommendations, Lynn, a few years later, extended to shooting-stars, for he observed that they were never noticed on cloudy nights, and must therefore always stay a considerable height above the clouds. Saussure and Spallanzani, also, at the end of the last century, on the Alps and Appenines, remarked that they appeared to be quite as high above their heads from the tops of mountains, as they usually appear from the level of the plains below. Two students at Göttingen, Brandes and Benzenberg, determined, in 1798, to sift this question to the bottom. An opinion had sprung up in Germany, of which a short outline may very well serve as an introduction to the third period, or that of explanation, in the history of shooting stars.

(3.) In the choir of the cathedral at Ensisheim (Alsace) there was preserved, until recently, a dark-looking stone

of large size, with a strange inscription, written in three languages, Latin, French, and German :—

> "In fourteen hundred ninety-two
> There happened here a great ado ;
> For close without, before the town,
> The seventh of November's moon,
> A stone was fall'n and there it lay,
> With thunder, and in open day!
> Two hundred and a half it weighed.
> Its colour iron. Then they made
> Procession, and 'twas hither borne,
> But much by force from it was torn."

The remainder of the stone, weighing only 16 lbs., was removed to the Museum of Natural History in Paris, where it is the most ancient known example of an aërolite of which authentic accounts have been preserved. Many such instances were however not wanting in later years, and a monk was struck and killed at Padua by an aërolite in 1660. Toaldo on this occasion proposed to consider them as projected from volcanoes on the moon. More recently, namely, in the year 1768, not less than three aërolites fell in different parts of France. Of these the stone of Lucé was given to be analysed by the French Academy to the great chemist Lavoisier, who four years later returned his opinion that the reputed meteorite was a mass of iron pyrites that had been disfigured by lightning, and at the same time exposed to view in the place where it was found. This mistaken verdict of Lavoisier led to the error by which certain nodules of iron pyrites having a rough surface and radiated structure are still vulgarly known in England by the name of "thunderbolts." These of course are totally earthy concretions, altogether different in their nature and origin from real meteoric stones. Montanari and Ferret had proposed to consider that aërolites are projected by earthly volcanoes, and Jussieu laboured to prove that aërolites are at least a different class of minerals from fossil shells or flint arrow-heads and implements. Nevertheless, after the verdict of Lavoisier, the reality of such occurrences was wholly discredited in France. Nor was opinion more settled with regard to luminous meteors, but one meteorologist, Toaldo, ascribed all fiery meteors to the combustion of pure "Phlogiston," or hydrogen, and Muschenbroeck attributed shooting-stars, like Aristotle, to humid exhalations from the ground, especially in marshy places, where, and on the banks of rivers, he remarked, their gelatinous residues might often be discovered on the ground. In 1752, Franklin and Dalibard discovered the source of lightning in atmospheric electricity. This discovery acquired great fame, and Pringle, in 1758, and Blagden in 1783, attributed to this agent the two remark-

able fire-balls observed in England in those years. The discharge of electricity is, unfortunately for this theory, exceedingly diffuse in thin air, while the light of fire-balls is brilliant and intense. The explanation of luminous meteors now generally accepted is that due to Chladni, of Wittemberg, well known for his researches in the theory of sound, and from whom are named the figures formed on glass and other flat surfaces, when strewed with sand, and made to vibrate with a musical note. Chladni visited Göttingen in 1792, where he became acquainted with Lichtenberg's electrical experiments, and was induced to reject the electrical theory of luminous meteors as altogether untenable. The work in which the new views of Chaldni were made known was published in April, 1794, under the title, "*The iron of Pallas and other masses of stone and iron reputed to have fallen from the air.*" In this work, Chladni supposes that all the accounts hitherto received of the falls of aërolites were founded in reality, and conjectures that the planetary velocity with which these bodies enter the air is sufficient, by compressing the air, to raise them to a heat of vivid ignition. The property of compressed air here assumed can be made evident by an instrument called a fire-syringe, in which air confined by a piston in a tube, and moderately compressed, readily ignites punk, tinder, or amadou. With greater compression a proportionately greater effect might be produced. In this way, not only the fused surfaces of aërolites, but also fire-balls and shooting-stars can be accounted for. It is only necessary to suppose that the latter kinds of meteors are so small as to be consumed before they enter the atmosphere to any depth, and both shooting-stars and fire-balls will be seen to be the same class of bodies as aërolites on a smaller scale.

(4.) To test this theory, Brandes and Benzenberg, in 1798, undertook to determine the heights and velocities of shooting-stars under the direction of Lichtenberg. The heights were found to be in perfect agreement with Chladni's supposition. Fire-balls and shooting-stars occur, namely, at a common height of forty to eighty miles above the surface of the earth. Their velocity is somewhat greater than that of the earth in its orbit, and (although they may sometimes *appear* to do so) they in reality never shoot upwards, but always downwards towards the earth. In this way Chladni's position was fully confirmed, and more attention came to be paid to the fall of aërolites than they had ever before received. A variety of explanations was at this time hazarded to account for the presence of the flying particles in space. Among these the theory of Toaldo, that meteorites were stones projected by volcanoes from the moon, obtained the most adherents, and

was advocated in succession by Olbers, Laplace, Poisson, Biot, and others. Lichtenberg was also of the same opinion, and as late as the year 1839, Benzenberg affirmed that shooting-stars migrated from the moon. He quoted Lichtenberg's remark, that "the moon was a bad neighbour to the earth, and pelted her with stones." Laplace and Poisson, however, abandoned this explanation on the ground that no projectile forces exist upon the earth or moon sufficient to eject the stones with planetary velocity. The native source and origin of fire-balls, shooting-stars, and aërolites, still remained to be discovered; and some advance in this direction was shortly afterwards effected by an extraordinary occurrence in America. On the morning of the 13th November, 1833, there was witnessed in the United States of America such a surpassing shower of luminous meteors that every description of the display appears to have fallen short of the reality. One fact, however, remained certain, that a perfectly similar shower to this was observed by Humboldt in Cumana on the morning of the 13th November, 1799; and another, that the meteors streamed outwards on all sides from the direction of a fixed point near the star *Gamma Leonis*, during the continuance of the shower. These two particulars Arago, the late French astronomer, declared to be decisive in favour of a new theory for the origin of luminous meteors. "They are," he said, "a new planetary world, beginning to be revealed to us;" they circulate *like planets* round the sun. Shooting-stars obey the Newtonian law of gravitation, and their orbits may be calculated like those of the planets or the moon. It is now a fact well proved by evidence that the November meteors return in their greatest magnificence every thirty-three years, so that their next central conjunction with the earth will take place on the 13th or 14th November, 1866.

(5.) Another date for periodical meteors, namely the 10th of August, was shortly afterwards discovered by M. Quetelet at Brussels, in 1836, and at this epoch may properly be said to commence the period of prediction. M. Quetelet predicted the return of this shower on the following 10th August, 1837, and the prediction was fully confirmed, and has not failed since to be verified in Brussels every succeeding year. M. Quetelet, moreover, prepared Catalogues of Star-showers in 1839 and 1841, and specified particular dates for their return, all of which, as will presently be shown, have since been verified. Of these showers, the meteors of the 10th of August, although not the brightest, are the most regular in their return. They appear to fail every eighth year, the last minimum having taken place in 1862; but the display of August 10th, 1863, is probably the brightest star-shower that has been witnessed in

England since the night of November 12th—13th, 1832, when it is related the horses of the mail between York and Richmond were terrified by the brightness of the meteors. Shooting-stars are now better observed, by awaiting their arrival every year upon the 10th of August, than they could have been at any former period of their history. Star-showers also return (but not regularly) on the 2nd January; 9th—10th, and 20th—26th April; 25th—30th July: 15th—23rd October; and 6th—12th December; with their radiant points respectively at υ Herculis, δ Virginis, α Lyræ, γ Cygni, ν Orionis, and θ Geminorum.

(6.) On the 10th of August, 1863, the tracks of twenty meteors were observed at the English national observatories in such a manner as to determine their heights and velocities with precision. On comparing these results with nearly two hundred instances formerly observed, a remarkable uniformity is discovered, and it may be stated on an average, with an error of not more than two or three miles, that shooting-stars, from the smallest visible to those as bright as the planets, appear at seventy-three, and disappear at fifty-two miles above the surface of the earth. Either a different composition must prevail in the second forty miles of the earth's atmosphere to account for this remarkable uniformity (perhaps the fluid which, according to Mr. Airy, occasions magnetic storms), or else we must admit that shooting-stars, whatever their size and splendour, are composed of such fragile materials, that they are all alike dissipated by an equal opposition of resistance. The lower portion of forty miles is generally called the crepuscular atmosphere from its giving rise to the phenomenon of twilight. The upper portion of forty miles might, in the absence of any other name, be termed the meteoric atmosphere, because it generates the light of meteors, but M. Quetelet assigns the names of stable and unstable to the upper and lower portions of the atmosphere.

(7.) Not only periodical meteors, but also ordinary shooting-stars, which may be observed in small numbers every night, are shown to belong to showers, many of which at present are as well determined as of those of August and November. They return with their attendant radiant points, without confusion or chance, at regular seasons of the year. Although not so rich in meteors, they are even more regular in their return, more constant and long enduring than the extraordinary occurrences of star-showers. The latter are evidently groups in circulation round the sun, but the meteors of August must compose a narrow ring encompassing the sun, for otherwise they could not return, on one and the same date, regularly every year, with only a single interruption,

and that apparently a small one, every eighth year. The ordinary, or general star-showers, on the other hand, compose belts of vast extent, and must either be the embers of former star-showers now absorbed by the earth, or else the original distribution of meteoric matter round the sun in its primitive unaffected order. We may suppose this matter to have been in a state of dust or infinitesimal division, so that in general the ordinary star-showers represent the primitive prevailing currents. Occasionally, and at some places, the currents of microscopic dust are found concentrated into shooting-stars; and these, by some unknown predisposing cause, have been collected into star-showers. Finally, it would appear that fire-balls themselves are nothing more than the compacted elements of star-showers.

(8.) On the morning of the 19th of October, 1863, a very luminous fire-ball was observed at Athens, under highly advantageous circumstances, by Dr. Schmidt, in such a manner as to illustrate by a striking example the ordinary composition of these meteors. The fire-ball advanced slowly through an arc of 80°, and during fourteen seconds it was kept in view by Dr. Schmidt in the field of a comet-seeker telescope magnifying eight diameters. The meteor appeared twin, or double, followed by a multitude of lesser companions, all of these advancing with parallel paths and drawing behind them parallel trains of light. Similar followers were visible to the naked eye, in a striking manner, in the great meteor of the 18th of August, 1783. In Cavallo's drawing (taken near London), there are depicted eleven such; in Robinson's (Newark) nineteen; and in Sanby's (Windsor Castle) there are thirty-eight followers to the meteor. In ordinary cases they follow the body of light so closely as to give the meteor an elongated appearance, compared to a wheatsheaf, a fish, a ninepin, etc., but at other times the meteor appears divided, double, or pursued by two or three balls, as in the case of Pringle's meteor of 1758, and the great meteor in America, on the 20th July, 1860. The ordinary forms are kite-shaped, pear-shaped, or globular. Besides the followers, a permanent streak often remains upon the track of a fire-ball, either fading away quickly or continuing visible for many minutes after the disappearance of the meteor. In the latter case it rarely remains straight, but changes its shape and position very sensibly, like a cloud transported by the wind. In all these respects, fire-balls resemble gigantic shooting-stars.

(9.) The heights of eleven fire-balls in England, in the years 1861-2, were found to be from 102 to 30 miles above earth's surface at the moments of first appearance and disappearance. Nearly fifty fire-balls observed before the date in question

(in the Old and New World), present the average values of 62 and 35 miles. The upper limit appears therefore sufficiently uncertain; but the lower limit is more depressed in the air than in the case of shooting-stars. Fire-balls which penetrate to within twenty miles of the earth's surface, generally produce violent concussions in the air, and are called *Detonating* fire-balls. These frequently precipitate stones upon the ground, and are occasionally called *Aërolitic* meteors, to distinguish them from the class of silent fire-balls, or *Bolides*. Bolides vary in magnitude from the apparent diameters of the planets to fire-balls which throw shadows, and are often brilliant and surprising objects at noonday. The velocities of bolides, as well as of detonating fire-balls, average more than thirty miles per second, and no distinction can be drawn in this respect between shooting-stars and fire-balls.

(10.) The coincidence of dates and directions evince the common origin of bolides and periodical shooting-stars. Only those fire-balls which are truly aërolitic will, it appears, require to be explained in a different manner. Among the 240,000 meteors said to have been visible above the horizon in America, during the night of the 12th—13th November, 1833, a considerable proportion consisted of fire-balls, varying in brightness from the apparent magnitudes of Jupiter and Venus to that of the Moon. The same was also observed in England, though on a less striking scale, on the night of the 10th of August, 1863. Shooting-stars and small bolides radiated on that night from ten o'clock till midnight, from the direction of the usual radiant point in Perseus. Again, a catalogue of nearly 1500 fire-balls, compiled from all previous catalogues, and from other independent sources, by Mr. Greg, shows that a large preponderance of fire-balls were observed on the dates of the 10th of August, 13th of November, and 6th—12th of December. Aërolites, on the contrary, are wanting on the same dates; for if the aërolitic date on the 13th—14th of December may be omitted, there is no approximation of aërolites to the star-showers of August and November. Fire-balls are shown by the catalogue to be abundant on the 10th of April and 18th of October, and on both of these dates star-showers have been observed. There appears therefore a variety of evidence to show that shooting-stars and fire-balls have a common origin; and furthermore that the sun is irregularly encompassed by zones of meteoric dust, concentrated at some points into shooting-stars and bolides, which by some unknown predisposing cause have been collected into star-showers. The concentration of the materials appears to have taken place without consolidation, nevertheless some portions might be so far compacted by chemical affinities or crystallization, as to

enter the atmosphere deep enough to produce concussions, but not to reach the ground. Aërolites, it will presently be seen, cannot have owed their origin to such a process.

(11.) The falls of aërolites must be reckoned very rare occurrences in England, but in Europe the number of falls recorded since the beginning of the last century to the present time exceeds 130. Aërolites are not (by any means) so frequent as earthquakes, but so violent are their concussions in the air, that they may have been at times mistaken for this cause. Some might also occur at night, and many in unfrequented parts, which could not be recovered and transmitted to museums. If the number preserved is reckoned at one-tenth part of those which have really fallen, this amounts on a moderate estimate to one meteorite per diem on the whole surface of the sea and land. This department of science is therefore likely to be extended by the increased facilities of intelligence and intercommunication which prevail in every part of the inhabited globe. At Barbotan, in the South of France, a perfect hail of stones took place on the evening of the 24th of July, 1790, from a large meteor which burst over the town, so that the inhabitants ran for refuge in their houses. This report was generally disbelieved in France, but specimens were nevertheless preserved in private collections. A shower of stones was again reported to have taken place at L'Aigle, in Normandy, on the 26th of April, 1803. J. B. Biot, an Academician from Paris, was deputed to inquire into the truth of these reports. Having provided himself with a specimen of the Barbotan stones, Biot proceeded to the spot, and soon assured himself of the truth of all that was related. Biot himself dug up a stone from the ground where it had fallen, and in a few days returned to the Academy the following report:—

"1. A violent explosion was heard at L'Aigle and for 80 miles in all the country round, about one p.m. on the 26th of April, 1803.

"2. A few minutes before the explosion was heard at L'Aigle, a luminous meteor with a very rapid motion was seen in the air, not at L'Aigle, but at several very distant places round.

"3. The explosion that was heard at L'Aigle was the consequence of the luminous meteor which burst in the air.

"4. Stones fell from the sky on the 26th of April, 1803."

More than 2000 stones fell, upon trees, pavements, and the roofs of houses, so hot at the moment of their fall as to burn the fingers when incautiously handled. One person was grazed by a stone upon the arm. This shower of stones extended over an area of oval figure nine miles long from south to north, and six miles wide. In this respect it was perfectly

similar to the shower of stones which fell at Stannern, between Prague and Vienna, on the 22nd of May, 1812. At six o'clock in the morning, after violent concussions, followed by rumbling noises for six or eight minutes, nearly 200 stones fell in the fields round Stannern, and were brought from the high road to the village in great numbers. Von Schreibers, who reported this stonefall to the Vienna Academy, collected sixty-one specimens of the stones, and consigned them to the Imperial Museum, where the greater number may still be seen. At the time of the stonefall at L'Aigle, only three specimens of aërolites were to be found in the Imperial Museum at Vienna, namely those of Ensisheim, Mauerkirchen, and Eichstädt, but after the occurrence of that at Stannern greater interest was awakened, and the Museum at the present day contains 220 specimens of meteorites. It is only exceeded in this respect by the magnificent collection at present exhibited at the British Museum.

(12.) The meteorites of Barbotan, L'Aigle, and Stannern are memorable instances of aërolitic showers. They must, in the opinion of Haidinger, of Vienna, have entered the air as a crowd or swarm of stones; but instances of solitary meteorites have also been abundantly recorded, of which the following are examples. The meteorite of Ensisheim, already mentioned above, is the earliest existing instance, and the large stone which fell in Yorkshire on the 13th of December, 1795, should be a familiar example to all who have visited the department of minerals exhibited at the British Museum. It is a cubical block weighing 56 lbs. The large meteorite which fell at Juvinas (Ardéche) in France, on the 15th June, 1821, although similar in its texture and minerals to the aërolites of Stannern, was a solitary stone. It weighs 220 lbs. Of meteorites which fell in smaller numbers those only need be noticed in which the height and velocity of the attendant fire-ball was accurately determined. The meteorites of Weston, in America, fell at daybreak on the morning of the 13th December, 1807, a date, like the 13th of October, justly rendered famous for aërolitic falls. The stones were few in number, and fell at three points of the meteor's path, corresponding, according to Bowditch, to three explosions which took place at heights of twenty-five to sixteen miles above the earth. The velocity of the meteor was estimated by Prof. Bowditch at only three miles per second. The two stones which fell at Charsonville, near Orleans, in France, on the 23rd November, 1810, were preceded by a fire-ball, of which the explosion and disappearance was estimated by Dutrochet at seventeen miles above the earth. They weighed 40 lbs. and 20 lbs. respectively, and are crossed by dark veins which give the mass a marble-like appearance. The meteorites

of Orgueil (in the south of France) fell at evening on the 14th of May, 1864, from a meteor apparently as large as the full-moon, which moved from east to west with a velocity of fourteen miles per second, descending from a height of forty to sixty miles above Nerac to fifteen or twenty miles above the town of Orgueil, where it burst, and the stones were scattered over several miles. They contain an unusual quantity of carbon, sulphate of ammonia, and other salts. The explosions of aërolites have been compared to those of "Prince Rupert's drops," small beads of glass brought into a high state of tension by sudden change of temperature at the surface. On the slightest fracture, they fly into a thousand pieces. This explanation is however doubtful: at least the stones so described cannot be made to decrepitate in the flame of the oxy-hydrogen blow-pipe. In the few instances, soon to be described, where disruption has certainly occurred, this took place when the heat on the surface had subsided. In ordinary cases separate fragments of meteorites cannot be fitted together into a single block.

(13.) Aërolites are invariably covered with a dark crust, not thicker than an ordinary playing-card, of their own substance, fused or molten into slag. This is evidently caused by the heat of the fire-ball by which at first they are surrounded. Chladni and Vauquelin supposed that the dark veins in the stones of Charsonville were portions of the black crust, cementing together broken pieces of the stone. Certain falls have, however, occurred to prove that no slag is formed upon meteorites after the time that they are broken by concussion. The meteorites of Quenggouk (in Pegu) for example, which fell on the 27th December, 1857, fit so exactly to one another at the surfaces which have not been crusted over, that the meteorite evidently parted after the fire-ball ceased to melt the surface. These pieces were discovered a mile apart. The meteorites of Butsura, which fell near Goorka, in India, on the 12th of May, 1861, are a more striking example in point. Five stones, in this case, weighing together more than 30 lbs., being joined together by their fresh uncoated surfaces, fit so exactly into one large uniformly crusted mass, that two fragments only are wanting at the angles to prove that the stone was only broken in pieces when the heat of the fire-ball had ceased to have any effect upon it. These fragments of a meteorite were found at four different places, lying two to three or even four miles distant from one another. Sections of this meteorite and its model are exhibited in the British Museum. With regard to veined stones like those of Charsonville, the opinion of Berzelius is more defensible that the black veins were formed in the primitive rock of which these stones are native pieces.

(14.) Some meteorites, called *aërosiderites*, are metallic iron, more or less alloyed with nickel. These kinds are generally found fossil, two only having been observed to fall from the sky, and these nearly a century apart. The first occurred at Agram in Croatia, on the 26th of May, 1751, weighing 72 lbs., and is preserved in the Imperial Museum at Vienna, where is also exhibited the aërosiderite of Braunau, that fell on the 14th of July, 1847. The largest fossil iron remains immoveably fixed in the desert of Bahia, in the Brazils. Another from La Plata, weighing 7 cwt., is exhibited in the British Museum. One was found at Var, in France; and recently a specimen, weighing 33 lbs., was dug up near Melrose, in Scotland. The iron of these blocks is nearly as regularly crystallized as a piece of ordinary spar, as may be shown by etching their polished surfaces with acid. Some meteorites (a good specimen is the meteorite of Hainholtz) are composed partly of iron and partly of stone. They are called *siderolites*, and the meteorite of Butsura, already mentioned, is not far removed from this class.

(15.) By far the greater majority of meteorites are *aërolites*, or stones resembling grey lava, with scattered grains of iron and pyrites, etc., and covered, as above described, with a shining or dull black crust. In their form they are rough, unshapen pieces, weighing from one to two hundredweights in the largest, and one or two ounces in the smallest specimens. The mixed minerals, mostly crystalline, of which they consist, have been studied with the microscope, and in the laboratory by chemical analysis. By the microscope they are shown to have been slowly consolidated from a state of fusion; and by analysis they are hardly to be distinguished from terrestrial lavas, excepting that iron, carbon, phosphorus, and nickel are present in a state uncombined with oxygen. Aërolites are, therefore, erupted or unerupted foreign lavas—specimens of the igneous frame of some unknown planet, melted in mountains, cooled in rocks, roughly broken off and projected into space. It deserves to be mentioned, as a curious coincidence, that the earliest well-known historical aërolite in existence, that of Ensisheim, fell upon the earth in the same year, and within a month of the same day, as that on which America was discovered by Columbus. The minerals brought back by Columbus and his contemporaries to the court of Spain did not furnish with more positive proofs of the existence in the Atlantic of a "New World," than the presence of a meteorite upon the globe supplies to astronomers, that planets are to be found in the vicinity of the earth, of which the positions and capabilities are not yet computed, even by Le Verrier and his most accomplished adherents. That bolides and shooting-stars owe their existence to belts of

matter in a state of extremely fine division encompassing the sun, it seems hardly possible to doubt. Aërolites, on the contrary, are fragments of solid stone, and of these the source and origin must at least be on a larger scale, and composed of the same materials. The conclusion appears inevitable that parent planets in the immediate vicinity of the earth, too small and powerless to reclaim their fragments, have scattered the lapideous morsels broadcast into space. These circulating round the sun with their initial projectile velocities, should the orbits of both intersect each other, must sooner or later encounter the earth.

(16.) It may be presumed that the suspected planets are situated within the orbit of the earth, because by far the greatest number of aërolites are experienced by day, while the sun is still above the horizon, and the largest detonating fire-balls occur about the time of sunset. In this way the passage of dark bodies across the disc of the sun, and more rarely across the disc of the moon, may be explained. For it can be calculated that a planet twelve miles in diameter, at ten times the moon's distance from the earth, subtending 1″ of arc at its passage across the sun, would appear as a morning and evening eighth magnitude star. But as at the time of its greatest brightness it would also be stationary, or nearly so, and almost lost in the rays of twilight, it is not impossible that such planets, if accidentally observed, should have been mistaken for fixed stars. Should the suspected planets, however, be situated outside the orbit of the earth, it is difficult to perceive how they could so long have eluded the gaze of our sharp-eyed astronomers, as their lustre in this case would be vastly superior. But in the meantime the bombardment of aërolites continues; and whatever may be their origin, some new light must before long be obtained from these "pocket-planets" themselves, as they have been termed by Humboldt, to settle the perplexing question, and to open out new fields for speculation.

INSTINCT OF BIRDS.

BY THE REV. JOHN WEBB.

THE following remarkable instance of instinct (or what we are pleased to call by that name) came under the observation of the writer:—

1863, July 26. *Scene*—Mrs. M.'s drawing-room. *Present:* Mrs. M——, Miss C. B——, Rev. J. W——. Two birds in two separate cages on the table—an Australian parroquet in a brass wire circular cage, with a hoop swing in it, the cage rather too small for the bird; a canary-bird in a cage of the shape of a parallelogram, larger, but with only a perch. The doors of each cage were opened, the doors of the room were closed, and the birds are set at liberty. At first they flutter about upon the chairs and tables, then amuse themselves by hopping about upon the carpet and picking up crumbs, now and then fluttering past each other without taking any particular notice. They had often been let out before; it was said that the canary bird was the master of the two. At last they make a little nearer approach; a few passes with the beak take place between them, but with little more than a flutter. At length the parroquet tries to bully his companion after the manner of the tribe, by facing him, and making a few rapid bows at him, without producing any very great impression. The canary-bird goes off to amuse himself, apparently not caring a straw about him; when, taking a few quiet steps (both cages having been placed on the ground), the parroquet advances to the door of his companion's cage—the larger cage of the two—hops upon the threshold, mounts upon the perch, and takes possession. This feat accomplished, the other, after a few *détours* about the room, discovers an intruder in his cage, sidles towards it, looks in, does not like the state of things, flutters off, makes two or three turns, hops on the threshold, looks in again, and is off again. When he was gone, the intruder descends from the perch, places himself upon the threshold, draws to the door with his beak, and with his beak makes it fast. What, is this an untaught bird? Is it instinct, or is it a spark of reason? The canary-bird perceives what he has done; got to the top of his own cage (which he had done before the door was shut), fluttered about to alarm the offender, who seemed to take no notice of it at all: he then made an expedition into the circular cage, did not like it, and came out again, fluttered about his own cage, got on the top of it, and appeared very uneasy.

One of the party present then opened the door of the canary-bird's cage, in which the intruder was sitting with

great composure. Presently the canary returned to his own home, entered, and placed himself upon the perch beside the parroquet. The latter at first took no notice; they had a few flutters about the cage, without any real fighting; the canary did not find it comfortable, and got out again, the other still keeping his hold. After this abandonment, while he was consoling himself by hopping about upon the carpet, the Australian descended from the perch to the threshold. And here he gave another proof of his sagacity; the door being wide open, and more difficult to draw to than when, as in the former instance, it was half open, after two or three ineffectual efforts with his beak to bring it to, he hopped down, went to the end furthest from the hinge, drew it half to, placed himself upon the threshold, finished the operation by closing it and fastening the wire latch once more. It remains to be added that the canary-bird, finding it impossible to get in, took possession of the other cage, but had not the wit to close the door of that, which was closed for him. Here a long struggle took place; he could not fix himself comfortably upon the perch; the swing hung too low, and in attempting to place himself in the centre, the swing came against his sides, and he continued to flutter from one end of the perch to the other, the swing still keeping in motion. At length, after many useless efforts, the swing hanging rather transversely and affording him a trifle more room on the one side than on the other, he selected the widest aperture of the two, trifling as the difference was, and the evening being now advanced, tucked his head under his wing, and went to sleep. Thus they passed their night. It is but right to add, that ultimately justice was done, and they were restored to their cages on the morrow.

THE PARTRIDGES OF BENGAL.

BY R. C. BEAVAN, LIEUT. BENGAL SURVEY DEPARTMENT.

THERE are three kinds of partridges commonly found in Bengal. The grey partridge (*Perdix Ponticeriana*, Hardwicke, *Ill. Ind. Zool.*, col. plate 213), the "*Gora tetur*" of the natives, is a bird very much like its English congener in colour, but a trifle smaller. It affords fair sport for the gun, but unless properly dressed, is not thought much of for the spit, being generally hard and dry. They are invariably found in pairs, in low bushy scrub, where the soil is dry, and occur in great abundance in the Rajhmahal Hills, the slopes of which are covered with low, thick, and thorny bushes, growing in a dry, stony soil.

The general method of shooting them is to employ beaters, who, armed with long sticks, and almost nude, work willingly the whole day for a few coppers, and forming line through the jungle, drive everything out before them.

This jungle seldom exceeds five feet in height, and the plan usually followed is for one or two of the guns to go ahead and look out for chances, while the remainder march with the beaters. The game thus procured consists generally, in the districts I am alluding to, of these "grey" partridges, hares, and quail, and it is well to have a servant near with a rifle, as often a deer or hog is disturbed, and sometimes even a tiger.

The grey partridge does not seem to care much about water, being generally found in very dry country, at some distance from cultivation or crops of any kind; its food consists chiefly of grass seeds, jungle berries, insects, and occasionally dhar or rice, when the fields of the latter run up, as they do in Maunbloom, between patches of thick cover.

The difference of the sexes is not perceptible outwardly, except by the spurs, with which the male bird is armed; these are very slightly developed in the female. According to Mr. Blyth, the habitat of this bird extends throughout India generally, as far as Ceylon, but it is not found to the east of the Bay of Bengal. The call of this species is loud and clear.

We next come to the black partridge (*Francolinus vulgaris*, Stephens, pl. 147, 148), called "*Kala tetur*" in Hindostanee. It is a much handsomer and finer bird than the grey, affording better sport, and considered equally superior for the spit. It is about the size of the English partridge, perhaps slightly larger. The greater part of the plumage of the male bird is black, varied with dark brown on the wings, and spotted sparingly with white on the breast; but the female is of a more

sober hue, a mottled grey and white, delicately pencilled in parts with dark brown.

Dogs are of great assistance in shooting this species, as they run but little, compared with the grey, afford good scent, and are often found in or near dry cultivation. I use the word *dry* advisedly; they are not found in *wet* or *rice* cultivation. They almost invariably get up in pairs. As far as my experience goes I have never seen or heard of such a thing as a *covey* of partridges in Bengal, three or four are sometimes found together, but they invariably, when disturbed, fly off in pairs.

The usual habitat of these birds is grass about three feet high, not far from water. They also frequent the fields of "*rahr dall*," a kind of pea grown largely in some districts to four or five feet in height, and affording good cover. Where plentiful, they give very good sport either with dogs or beaters, and make a welcome addition to the cuisine of a hungry traveller. They have a peculiar sibilating call, low but clear, very much like that of the English grasshopper lark, at one moment appearing to issue from the grass close by, at another some hundred yards off. Their food consists of grain and various grass seeds. They are to be found plentifully in the dry grass savannahs bordering the Ganges, to the north of Moorshedabad and the base of the Rajhmahal Hills, and in all favourable localities in Upper Bengal. The range of this bird seems large. Blyth, in his catalogue, gives Afghanistan, Persia, Syria, Cyprus, Sicily, and North India, as their habitat. I have found them abundant in the Maunbhoom jungles, and they probably extend as far south as Midnapore.

A third species is the khyer partridge, *Perdix gularis*, Tem. (Hardwicke, *Ill. Ind. Zool.*), sometimes called the Bengal chickoor, or wood partridge. This is a large bird, and weighs, when full grown, $1\frac{1}{2}$ lb. In several places along the banks of the Ganges, and of some of the other large rivers in Bengal, there is a strip of low land on either side, which is periodically flooded when the rain causes the rivers to rise. On their subsiding, this soon gets covered with a thick jungly growth of high reeds, intermingled with thorny bushes of a white dog-rose, which together form an almost impenetrable mass of vegetation, in places some 16 or 20 feet high, affording capital cover for wild buffaloes, pigs, deer, etc. On the gradual fall of the river Ganges, various irregularities in the ground in this tract of country remain filled with water, forming small lakes, which, scattered here and there, soon get surrounded by the above-named dense vegetation. In the beginning of the cold weather, one can run up by train from Calcutta, and in one day reach these fine shooting grounds, which extend for miles along the base of the Rajhmahal Hills,

and the Caragola side of the river, and are invariably well stocked with these partridges. They are always found close to these small pools of water, and frequent the densest part of the high reeds. If one attempts to beat them up in the day time it is necessary to force a way through the tangled mass on an elephant; and though, with five or six more as beaters, plenty of birds will be put up, it is extremely difficult to recover them when they fall into the thick jungle. The best plan is to go out with men as beaters, either in the morning or evening, when the birds leave their almost impenetrable coverts, and venture out into the lower grass to feed; then capital sport may be had, as on rising they immediately make for the thick cover, and when beating at right angles to it, must necessarily pass along the whole line. The gun nearest the cover has, of course, the best chance; but unless he kills his bird dead, it is quite useless hunting for a wounded one in the tangled mass. They often perch upon the rose bushes, and give good chances to the pot-hunter. The bird is of a grey colour, handsomely barred across the thigh coverts with brown, and streaked on the breast with the same colour. It is quick in flight, and requires a hard blow to bring to bag; and last, though not least, is capital eating. Its range appears limited to the country between the Himalayas and the Ganges, and not higher up that river than Benares.

Near Caragola Ghaut a couple of good guns may in a few hours bag eighteen or twenty brace, with about a dozen or twenty beaters, which is very good sport indeed for India, where birds are never preserved. The high reeds that form this thick cover are the same that, cut in small pieces, are sold all over India for the purpose of making pens suitable for writing the native character. When cut down close the stumps are rather dangerous, often piercing the boot and running into the foot; but if, on the other hand, one discards this open but thorny ground, another danger is likely to occur, which once happened to a friend. As he was raising his gun to fire at a bird which had just got up, one of these reeds caught in the trigger, the gun went off while yet low, and the charge penetrated a thick bush a little ahead of the beaters, from which immediately issued a series of terrible shrieks. Soon, two small boys were brought to light, badly lacerated by shot, one with his eye put out. It appeared that, contrary to orders, they had smuggled themselves in with the rest of the beaters, in the hope of getting a few pice, and being so small, had managed to wriggle ahead more easily than the men through the reeds. They were both sent off to the nearest hospital, distant thirty miles, and their disconsolate parents easily comforted with a present of a few rupees.

The fourth, and last, Bengal species is, from its limited range, but little known. I allude to the double-spurred partridge, *Galloperdix lunulosa* (Hardwicke, *Ill. Ind. Zool.*, and Jerdon, *Ill. Ind. Zool.*, pl. 42), generally called the Spur Fowl. It is about the size of the grey partridge, but much handsomer. It is coloured with a kind of dark bronze on the wing coverts, which gives to the bird when first shot the appearance of a general green hue. This fades after death, and it then appears dark brown on the back, blackish about the head, neck, and tail, and chrome yellow on the breast; the whole, except the tail, speckled with black and white lunules or spots.

This species is pretty common in the Rajhmahal Hills, near Hazareebaugh, and extends throughout the Maunbhoom jungles towards Midnapore. It is also found sparingly in Beerbhoom. Its native name in Maunbhoom is "*asko*."

Its habits partake much of those of the jungle fowl, *Gallus ferrugineus*, which is also found in the same jungles. Its food consists of seeds, rice, grain, and the flowers of the *Mhowa* tree (*Bassia latifolia*), which abounds in the Maunbhoom district, and generally throughout Chota Nagpore, and is much sought out, when its waxy flowers fall, by all kinds of game, both winged and fourfooted. Bears and various species of deer are excessively fond of them, as also are the peacock, jungle fowl, and most partridges. The natives, too, collect and distil from them a spirit called dārū. This partridge does not give good sport. It frequents thick bushy jungles, and runs rapidly through it when disturbed, but is good eating when kept until tender.

LITERARY NOTICES.

COSMOGONY, OR THE PRINCIPLES OF TERRESTRIAL PHYSICS. By EVAN HOPKINS, C.E., F.G.S., Author of "Geology and Magnetism." (Longmans.)—Mr. Evan Hopkins, like Mr. Kelly, whose lucubrations were noticed in our last number, desires to reform geology, so as to do away with the long periods supposed necessary for the formation of the various strata. He does not, however, resort to the steam-grinding apparatus of the last-named philosopher. His process is more simple. Electro-magnetism is the motive power on which he relies. He has convinced himself that, during the last 2140 years, "the entire surface of our globe has moved to the north-west in a spiral path 30°, and northward 12°." He invites us to reject any astronomical or geological doctrines that do not coincide with this hypothesis, and he tells us that "the south polar basin is the starting-point of the embryo of the crystalline film of our globe, *i.e.*, our terrestrial habitation; and the north polar basin is the receptacle of the final dissolution of all terrestrial substances."

HOMES WITHOUT HANDS. By the REV. J. G. WOOD, M.A., F.L.S. (Longmans.)—The recent numbers of this entertaining work fully maintain Mr. Wood's reputation as an admirable popularizer of natural history. He comes in No. 14 to the weaver bird, the hive bee, the hornet, and several other sociable insects, the "homes" of which he describes. No. 15 contains an account of driver ants, mud wasps, and corder bees, and then passes to the curious question of parasitic nests, of which several illustrations are given, taken from the domestic economy of both birds and insects. The illustrations are, as usual, numerous and good; and we can only repeat what we have said in former articles, that "Homes without Hands" is a good and instructive family-book.

THE PAUPER, THE THIEF, AND THE CONVICT: Sketches of some of their Haunts, Homes, and Habits. By THOMAS ARCHER, Author of "Wayfe Summer," "Madame Prudence," etc. (Groombridge and Sons.)—Few persons will go for themselves into the haunts of wretchedness in which town crime is so prolifically bred; nor will many become personally acquainted with the physiognomy of the workhouse or the jail. It is, however, an indispensable foundation for reformatory efforts, that the condition of the erring and suffering classes should be distinctly understood. In many cases, terrible poverty is patiently borne, without its immediately or directly leading to actual delinquency. This is the case when a once-thriving class like the Spitalfields weavers have become depressed, and still retain many heart-touching traits of tastes and habits which belonged to better days. Below these unfortunates are thousands who have not even the traditions of a happier state of things to fall back upon, and they furnish a constantly-recruited army of pauperism and crime. Mr. Archer has put into a compact, well-written book a great deal of information concerning our

depressed population. He gives enough of their dark surroundings and deplorable habits to make his picture striking as well as true, and he judiciously avoids details that are not fit for family reading. If the subject were not so intimately connected with human misery, we should call his pages very entertaining: interesting they certainly are, and carry their instruction with them. The chapters, "Amongst the Poor," "Tiger Bay," and "Weasels Asleep," strike us as excellent of their kind; and the book cannot fail to assist in rousing the intelligent and benevolent part of the community to the necessity of dealing, on a large and bold scale, with evils that minor efforts may expose, but cannot correct. Every large town has whole streets, or districts, which are nothing else than elaborately-arranged factories for the production of pauperism, disease, and crime. No circumstance of dirt, filth, darkness, bad ventilation, ignorance of what is good, and early acquaintance with what is bad, is wanting in these horrible localities; and although they may lie close to respectable or even wealthy neighbourhoods, they seem as far out of the influence of civilization, and as far removed from the eye of the happier portion of society, as if they were situated in a remote quarter of the globe. Mr. Archer's travels in such regions have enabled him to describe them with graphic power.

The Public Schools Calendar for 1865. Edited by a Graduate of the University of Oxford. (Rivingtons.)—This work is, we believe, quite new in the extent of its plan. Preference is given, as the preface tells us, to the nine public schools forming the subject of Her Majesty's Commissioners' Report. The school lists of these nine, and the roll of cadets at Woolwich, are given in full, as well as the honours' lists of all the schools. Various other schools are described, but the list does not pretend to include every school to which the name of "public" properly belongs. In future years, we should recommend an extension of the list; but we suppose to make it complete would change the size of the work. A great deal of information has been collected together concerning the studies, discipline, and amusements of the various schools, and the work supplies a void in this kind of literature which its editor has well filled up.

The Anthropological Review, No. 8. (Trübner and Co.)—There is interesting matter in this number, which includes the Journal of the Anthropological Society of London. We cannot say we admire the tone of the reviews. They lack a calm, philosophical spirit, and trench on the ludicrous in passages intended for fine writing. The most important paper is a reprint from the *Canadian Journal*, in which Dr. Wilson discusses the peculiarities of the ancient and modern Celt of Gaul and Great Britain. The information on the extent of the tendency towards an unsymmetrical development of heads is very curious.

The Astronomical Register.—The successive numbers of this useful periodical meet the wants of a considerable body of observers. The information supplied is generally very good; but one of the

contributors, who calls Uranus not worth looking at, except with very large telescopes, should not be attended to. A good 3-inch glass gives an image of this planet which it is very interesting to contrast with that afforded by any small star.

NEW ENTOZOOTIC MALADY: Observations on the Probable Introduction of this Formidable Disease, and on the almost inevitable Increase of Private Diseases in general, as a Consequence of the Proposed Utilization of Sewage. By T. SPENCER COBBOLD, F.R.S., F.S.L. (Groombridge.)—We recommend attention to Dr. Cobbold's "Entozoa," a work which embodies an immense collection of information relating to parasites. The utilization of sewage cannot be stopped by an alarmist pamphlet, but the knowledge conveyed in Dr. Cobbold's important treatise cannot be too widely diffused, if the great evil of parasitic disease is to be kept down.

FUNCTIONAL DISEASES OF THE STOMACH. Part I—Sea-sickness; Its Nature and Treatment. By JOHN CHAPMAN, M.D., M.R.C.P., M.R.C.S. (Trübner and Co.)—The discovery that the sympathetic nerve causes contraction of the blood-vessels led Dr. Chapman to believe that, by exciting or diminishing its action, he could diminish or augment circulation, and thus obtain a remedial power over certain disorders. Experiment verified his anticipations that circulation could be increased by applying cold to the back, and thus diminishing the contractile action exerted by the sympathetic on the arterial vessels. Dr. Chapman first employed his process on epileptic patients, and he now recommends a sausage-like bag filled with ice, and laid down the spine, as a cure for sea-sickness. Many cases are mentioned of the success of the plan, and the patients describe it as less uncomfortable than would be supposed. Perhaps a more complete study of narcotics will enable the same result to be accomplished by the aid of some substance having a specific action on the sympathetic system.

HEAT CONSIDERED AS A MODE OF MOTION. By JOHN TYNDALL, F.R.S., etc., Professor of Natural Philosophy in the Royal Institution, and in the Royal School of Mines. Second edition, with additions and illustrations. (Longmans.)—We are glad to welcome a second edition of this admirable work, which is increased by some seventy pages of new matter, embodying researches completed since the publication of the first edition. It is undoubtedly one of the most valuable and profound books which this generation has produced. And the learned professor deserves great praise for avoiding the besetting sin of ordinary scientific men, who seem to fancy that their reputation for wisdom will be increased by the dryness of their style and the number of unintelligible words they employ. Professor Tyndall is eloquent, simple, and clear, exemplifying the double genius of discovery and exposition.

THE OLD CITY AND ITS HIGHWAYS AND BYWAYS: Sketches of Curious Customs, Characters, Incidents, Scenes, and Events, illustrative of London Life in Olden Times. By "ALEPH," author of "London Scenes and London People." (Collingridge.)—This is another of

"Aleph's" pleasant, gossiping books about London, which is all the more valuable, as the rapid changes going on in the metropolis lead to the rapid destruction of the architectural and other links between the present and the past. The subjects touched upon in this volume are very numerous, beginning with a "Bargain at the Auction Mart," and ending with "Twelfth Day" as it was celebrated by our forefathers. "Milton as a Londoner" is a very agreeable paper. "Aleph" is evidently a fervent admirer of the great poet, although his political sympathies are the very opposite of Milton's. The sketch of "James Lackington" is another good paper, and, indeed, we might find something commendatory to say of each. The illustrations—three dozen in number—are well executed, and the volume presents a handsome and appropriate appearance, with its red edges and substantial binding.

ARCHÆOLOGIA.

At the meeting of the British Archæological Association, March 8, the Rev. E. Kell, F.S.A., gave an account of the discovery of Roman Buildings in the Isle of Wight, which form a rather important addition to our knowledge of the Roman occupation of that island. In the Roman period, a road ran across the Isle of Wight from north to south, from what is now called Gurnard, or Gurnet Bay, where it is called Rue Street, by way of Niton to Puckaster Cove, where there was, probably, a port for shipping. At the termination of this road, on the northern coast, the shores of Gurnet Bay have been much gained upon by the sea, which has left them in low cliffs. Under these cliffs, near the Rue Street, fragments of objects formed of metal, tiles, and other building materials, and other objects of evident antiquity, had been frequently picked up on the beach, but without attracting much interest, until, during the last autumn, the occurrence of Roman coins among the objects thus gathered up, excited the attention of a local inquirer, and he was led to examine more carefully the face of the cliff, in which he discovered, at about a foot below the top, the line of the floor of a building formed of small brick tessellæ. This led to excavations on the ground above the cliff, and the foundations and floors of buildings were uncovered. These buildings, which ran east and west, consisted of three distinct rooms, of no very large dimensions, the southern wall of which remained to a length of forty-two feet seven inches, and the northern wall, which had suffered greater dilapidations from the inroads of the sea, to an extent of thirty-five feet. Two of the rooms included within these walls were about fifteen feet long, by nearly ten feet wide, and were paved with the small square tiles which form the usual floors of the inferior rooms in Roman villas in Britain. The western termination of one of those rooms has been carried away in the fall of the cliff but the other, or middle room, was found to be

perfect, except that the floor was much broken. In this room a quantity of broken Samian ware and other pottery, as well as a few coins, were found scattered about. To the east of this was the third room, which was entered from the apartment last described by a door, and had in the middle a large flat stone, on which, as we understood the description, ashes were found. On this account, we suppose, Mr. Kell assumes this stone to have been a fire-place, and the room a kitchen. In different parts of this room were found what Mr. Kell terms a bill-hook or chopper, the blade of which is six inches and a half long and three broad, and the handle eight inches and a half long, a knife handle, abundance of broken earthenware, chiefly of a coarse description, bones of animals, oyster and limpet shells, and one Roman coin. A consideration of these buildings can leave no doubt in our mind that they formed part (probably of one side of the court) of a considerable Roman villa, the principal apartments of which probably lay to the westward, and have all been washed away by the sea. The remains of charcoal and burnt materials scattered about show that, like most of the Roman villas in these islands, this had been destroyed by fire. A great abundance of roof-tiles and slabs of stone were also strewed over the floors and on the ground outside the walls; the roof-stones formed, as usual, in hexagons, so that by lapping over each other they formed lozenges.

The latest of the coins found in removing the remains of these buildings was of the Emperor Gratian, which brings us down to the latter part of the fourth century. The pottery consisted of some fragments of Samian ware, of no great interest, and of a quantity of broken earthenware of the common sorts usually found on Roman sites in Britain, some of which was identified with the ware, of which the potteries have been traced in the New Forest, at Crockle. Besides these objects, and a few fragments of iron and bronze, there were found a quantity of what Mr. Kell describes as "leaden tickets," which bear some resemblance, though rather distant, to the leaden Roman stamps found at Brough-upon-Stanmore, and described in a recent number of the INTELLECTUAL OBSERVER, in our notice of Mr. Roach Smith's *Collectanea Antiqua*. These "tickets," which are round, and about the size of an English farthing, are marked, some with letters, and others with ornaments. Mr. Kell suggests that they were used as tickets to some sort of merchandize of which a traffic was carried on in this direction; and he imagines, without any apparent reason, that they were connected with the ancient tin trade. A closer examination, however, tends to dissipate our ideas of their great antiquity; and, accordingly, Mr. Syer Cuming, the honorary secretary of the Archæological Association, declared that they were all of quite modern manufacture, and explained them in a manner which appeared perfectly satisfactory. A few of them appeared to be leaden weights which had been attached to fishermen's nets to make them sink, while the rest were the small leaden medalets or buttons called by boys *dumps*, and used for playing at a game to which boys give the same name. Mr. Kell mentioned several objects found on this site which were undoubtedly of

modern manufacture, among which were two or three leaden buttons, which he supposes may be of the fifteenth century; but he places among the genuine Samian ware a fragment of pottery of extremely beautiful workmanship, with ornament in relief, which was undoubtedly made in the seventeenth century.

This circumstance of finding OBJECTS OF MODERN MAKE AMONG ANTIQUITIES in the original and undisturbed deposit of the latter is a fact which has now been often observed, and is deserving of particular attention in connection with another class of researches carried on with great zeal at the present day. It is no doubt the result of different accidents, some of which are easily understood, while others are more difficult of explanation. We have met with articles of modern manufacture lying on or near the floor of a deep Anglo-Saxon grave, which had never been opened, among the objects of the original deposit. This and other similar cases can only be explained by circumstances with which we are not well acquainted, but which caused the heavy body in those cases to sink gradually in the ground. Some years ago, when a tumulus, called British, was opened, we believe in East Yorkshire, a tobacco-pipe was found nearly in its centre, and the excavators supposed at first that they had found evidence of smoking among the ancient Britons; but when the pipe was examined by somebody acquainted with the history of pipe-making, it was pronounced to be of the age of James I. or Charles I. As there were indications of old disturbance in the tumulus, we must suppose that some people had dug into it in search of treasure in the first half of the seventeenth century, and that one of the diggers had dropped his pipe into the hole before it was filled up again. Yet some antiquarians of eminence and name have been nearly betrayed into believing such tobacco-pipes to be Roman, or perhaps even Celtic. Among these are Dr. D. Wilson, who, in his *Archæology of Scotland*, states his conviction that they are of much greater antiquity than the date assigned for the introduction of tobacco into England; and Dr. Bruce, who, in the last edition of his excellent work on the Roman Wall, asks, "Shall we enumerate smoking pipes, such as those shown in the cut, among the articles belonging to the Roman period? Some of them, indeed, have a mediæval aspect, but the fact of their being frequently found in Roman stations, along with pottery and other remains undoubtedly Roman, ought not to be overlooked. The specimens in the cut are one half the size of the original; the larger of these is from the Roman station at Pierce Bridge, the smaller from the north of Northumberland. Some have been recently found at Bremenium." Any one acquainted with the history of the manufacture of these pipes will recognize the two examples given in Dr. Bruce's cut as figures of pipes belonging to the earlier part of the seventeenth century. Similar pipes are described by the Abbé Cochet, in his *Normandie Souterraine*, as found on Roman sites in France, and even that careful antiquary seems to have been almost persuaded of their great antiquity. This circumstance of the occurrence of objects undoubtedly modern in immediate association with others which may be pronounced with equal confidence to be ancient,

is important in connection with the researches now pursued with so much earnestness among the monuments of the antiquity of man.

One of those curious heaps of the *débris* of the refuse from the tables of our primitive forefathers, which the Danish antiquaries call KÖCKEN-MÖDDINGS, and which we might translate by kitchen-middings or kitchen-mixens, has recently been found AT NEWHAVEN, in Sussex, and we believe that a full account of it is in preparation, to be read at a future meeting of the Anthropological Society. Among the objects found were limpet and other shell, bones of several animals, a few flint flakes, broken pottery, and two or three rather fragmentary objects of metal. Among the latter are a leaden hook, which appears to have been intended for a fish-hook, and a small coin, but in such a dilapidated condition that it cannot be identified. The pottery appears to be all of the Roman period, and presents several specimens of the dark-coloured ware, made in what some antiquaries have termed smother-kilns, and two fragments of fine Samian ware. The flint flakes were found, as we understand, above the Samian ware. They all belong, probably, to the later Roman period.

The attention of the Society of Antiquaries of Scotland has been called, at a recent meeting, to the existence of ARTIFICIAL ISLANDS OR CRANNOGS, as they are called, in the Scottish lakes. They are represented as formed by stockading, and intended evidently for places of temporary refuge, and not as permanent residences, in which circumstance chiefly they differ from the pile-buildings of Switzerland. One of these stockaded islands, of which an account was given at a recent meeting of the Scottish Antiquarian Society, is situated in the loch of Dowalton, in Wigtonshire, on the property of Sir William Maxwell; but others were mentioned as having been destroyed within the memory of living people, without any observation of the antiquities which were found in them, and it is believed that many of them yet remain. A short account was also given of a crannog found in a moss near Applegarth, in Dumfriesshire, which consists of a platform of oak-trees resting on moss, and covered by moss of six or seven feet in depth. This foundation platform was covered with layers of brick, twig, and bracken, and, as far as it is at present uncovered, is about a hundred and fifty feet in length by twenty or thirty in width, with the appearance of a hearth at one point. Among the objects found at the Dowalton crannog was a bronze dish of Roman manufacture, which was the only object indicating a date. T. W.

ROMAN VILLA IN THE ISLE OF WIGHT.—A correspondent remarks concerning the Roman villa at Gurnard Bay. "The excavations appear to have been but partially carried out, and without much method; but portions of the limestone walls, the material for which is found on the spot, may be traced. The flooring, also, of one apartment, with its small square red tiling, is exposed in a good state of preservation. From the discolouration of one portion of the stonework, it is presumed the situation of an oven or flue is well determined. The remains stand on what is now the extreme verge of the

cliff, and, from the formation of the latter being alternating beds of clay and limestone, they are rapidly falling in and wasting away; indeed, so much so, that in all probability scarce a vestige of the remains will appear after the usual high tides of the spring."

PROCEEDINGS OF LEARNED SOCIETIES.

BY W. B. TEGETMEIER.

CHEMICAL SOCIETY.—*March* 2.

Action of Silicate of Soda on Cotton.—The injurious action of the soluble glass or mineral sizing used in cotton printing is well known, the strength and durability of the fabric being materially injured by its employment. Dr. Crace Calvert considered that the injury depends on the deposit of liberated silica in the cotton cells, and that the fibre is then weakened by the caustic action of the free alkali. Drs. Frankland and Abel, on the other hand, differed from Dr. Calvert, regarding the inquiry as being of a mechanical rather than a chemical character, and as being due to the expansive force exerted by the carbonate of soda as it crystallizes, after being set free from the silica. The consideration of this subject is an important one, in a domestic as well as a manufacturing point of view, as the employment of the crystallized carbonate of soda used in washing is known to have a very injurious effect on the strength of cotton fabrics washed by its aid, unless it is completely removed by pure water before the process of drying.

GEOLOGICAL SOCIETY.—*March* 8.

The Fossils of Windmill Hill, Gibraltar.—A very interesting communication was received from Mr. Busk and the late Dr. Falconer on the fossils of the Genista Cave of the Rock of Gibraltar. The authors stated that the rock abounds in both seaboard and inland caverns, the Genista Cave being one of the latter class. It has been traced downwards to a depth of 200 feet, but the external aperture has not yet been discovered. It was stated to be full of the remains of quadrupeds and birds, some of the former being now wholly extinct; others, as the *Hyæna brunea*, are now extinct in Europe, and repelled to distant regions of the African continent; while others again live now either on the rock or in the adjoining Spanish peninsula. It was inferred that there had been a connection by land, either circuitous or direct, between Europe and Africa at no very remote geological period. The authors observed that the wild animals whose remains were discovered evidently lived and died upon the rock during a long series of ages.

ROYAL GEOGRAPHICAL SOCIETY.—*March* 13.

On Stereoscopic Maps of Mountainous Countries.—Messrs. Galton described a new application of photography to the delineation of mountainous districts, whereby stereoscopic slides of the ordinary size could be printed for the use of tourists. The best maps fail to impart a correct idea of the inequalities of mountainous regions; this can be done only by models in relief, which are, of course, too cumbersome to be of use in travelling. By taking stereoscopic views of good models (previously coated temporarily with white paint), and giving an index of names of places on the back of each slide, referring to numbers on the stereoscope, all the advantages of a model could be given in a portable form, which could be viewed with a common eye-glass stereoscope, to be carried in the waistcoat pocket. In the case of models representing a large area they could be divided into squares, and separate stereographs taken of each division. This method offers great advantages for the illustrations of guide books of mountainous districts.

MANCHESTER PHILOSOPHICAL SOCIETY.

Development of the Wings of Butterflies and Moths.—An interesting paper was read by Mr. Sidebotham on the great and rapid increase in the size of the wings of Lepidopterous insects immediately after they emerge from the chrysalis. This increase is caused by air, which is taken in through the spiracles or breathing pores, and sent into the vessels of the wings. By this means the membrane is expanded, and the scales which were previously packed under each other as closely as possible are forced to slide out, until they are arranged in the same manner as the scales of a fish or the tiles on a roof. The wing of a moth in an unexpanded state, before it has emerged from the chrysalis, is not folded, but lies perfectly flat; and all the markings can be seen in miniature as indicated by the edges of the scales, which are then alone visible.

PROGRESS OF INVENTION.

Adaptation of Photography to Wood Engraving.—Among the numerous advantages derived from photography, none is of greater importance than the assistance which it affords to the artist. But its uses, in this respect, have been greatly circumscribed by the fact that, hitherto, it has been almost impossible to avoid the necessity of transferring the picture, by the tedious and necessarily imperfect means of the pencil, to the wood on which the designs are to be reproduced. There is no difficulty in obtaining the photograph on the wood itself; but, unfortunately, in doing so, the nitrate of silver employed disorganizes it, and destroys its most valuable properties. A varnish may, it is true, be used to protect the wood; but then it is difficult, if not impossible, for the engraver to perform his part of the process with delicacy and effect. The use of the *Worthley type*,

however, puts an end at once to all these inconveniences. Not only does the uranium-collodion contain so little of the silver salt as to be perfectly harmless; but, when the picture has been obtained, the collodion may be removed, by means of soft cotton dipped in ether, and the image will be found on the surface of the wood as distinct as, and infinitely more perfect than, if it had been produced by the pencil.

A Simple Clock.—Clocks have, long ago, been constructed which were capable of going for a very considerable time with one winding up. But they have been found objectionable, from their great weight, complication, and costliness. A clock was presented to the Society of Natural Sciences, at Versailles, which it is stated will go without winding for a year, or even a longer period, and yet is liable to none of these objections. The only difference between it and an ordinary clock is stated to be, the replacement of the pendulum by a horizontal lever, which is made to oscillate by the torsion of an elastic vertical wire. Varying the dimensions of the lever, varies the rate of oscillation—that which was presented to the Society vibrated once in six seconds.

Self-Acting Apparatus for Steering.—Electro-magnetism has been already applied to purposes so varied and so numerous, that it would be difficult to enumerate them. It has recently been proposed to employ it in the steerage of ships. The idea is both novel and ingenious, and, therefore, deserves attention, although, in its present state, it can hardly be deemed either simple or reliable enough, in practice, to secure the attainment of the object contemplated.

Dr. J. P. Joule proposes to attach to one end of a compound system of needles, or magnetized bars, suspended with great delicacy, a bent wire or commutator, one extremity of which will dip into a central mercury cup, connected with one pole of a galvanic battery, and the other extremity into the one or the other of two concentric semicircular mercury troughs, which are, respectively, in connection with two electro-magnets, and, through their helices, with the other pole of the battery. Which of the electro-magnets will be excited will depend on the position of the ship at the time, with reference to the plane of the magnetic meridian, as on this will depend the mercury trough which, by means of the commutator, will be brought in connection with the central mercury cup. Whichever of the magnets happens to be excited, will attract an armature placed between both of them: and this, by means of levers, will act on valves, so as to cause steam to move a piston in one direction or the opposite, as may be required, until the vessel shall have returned to its proper course. It is obvious, however, that, were no other objection to suggest itself, in practice, the pitching and rolling of the ship must be very likely to seriously interfere with the action of such an apparatus.

Photographic Enamelling.—M. Poitevin, to whom the Academy of Sciences awarded the Trémont Prize, for his discoveries in litho-photography, on the 6th of February last, had advanced, step by

step, until at length he found the method of fixing, on any substance, by means of materials which become hygrometric under the influence of light, carbon, metallic oxides, and other impalpable powders. And the development of this principle led to his discovery that a mixture of tartaric acid and perchloride of iron, which, when acted on by light, becomes hydroscopic, is well suited for fixing metallic oxides on enamelled plates, so as to give the utmost permanency to photographs, by transforming them into enamels. Thus an immense stride in progress was made at once; perishable compounds of silver and gold being replaced by substances of the greatest durability.

A Simplified Pump.—We have already * directed the attention of our readers to one simplification of the common pump; another, which would seem to be still more generally applicable, is coming into use. In the modification already alluded to, the valve in the piston was rendered unnecessary; in that we are about to notice, the piston itself is discarded, The vacuum is obtained by means of a *diaphragm*, which divides the suitably formed chamber of the pump into two compartments. When the diaphragm is moved towards one extremity of the chamber by a rod, one end of which is attached to its centre, the space at the other side is enlarged, a vacuum being formed, and water rushes in through a valve to fill up this vacuum. When the diaphragm is moved by the rod in the opposite direction, the water which has just entered is driven forward in any required direction; a vacuum being at the same time formed at the other side of the diaphragm. The movement of the rod, therefore, in each direction causes both water to enter the chamber to fill up the vacuum, and water to be forced from the opposite side of the chamber. The action is, by consequence, both as to suction and forcing, almost continuous.

Production of a Vacuum by Means of Ammonia.—The emptying of the cesspools in Paris has always been attended with great inconvenience. Among the methods proposed for obviating this, has been the use of air-tight tanks as carts, the causing a vacuum within them by pumping out the atmospheric air, and then filling them, when arrived at the cesspool, by atmospheric pressure. In theory this method was excellent, in practice it was found impossible to maintain the vacuum for the required length of time. M. Tellier, who suggested liquified ammonia as a source of motive power,† considers that gaseous ammonia may be used for the production of a vacuum in these tanks. For this purpose, he would have at the establishment whence the carts are to be despatched, a boiler containing water of ammonia. From this, gaseous ammonia is to be liberated by heat, and transmitted to the tank in which it is intended to form the vacuum. The atmospheric air is thus driven from the interior of the tank; and any ammonia that may pass off along with it is to be retained by water, through which the mixture is passed for the purpose. Ammonia is allowed to enter the tank,

* Intellectual Observer, No. xxxvii. p. 78.
† Intellectual Observer, No. xxxviii. p. 148.

until the pressure within it very slightly exceeds that of the external atmosphere; there will then be little tendency to leakage, but if a leak should exist, it will be readily detected and stopped. When the tank arrives at its destination, it is to be put in connection with the receptacle to be emptied, and at the same time with a small quantity of water properly situated for the purpose. The ammonia is, of course, instantly condensed, a vacuum is formed, and the tank is filled by atmospheric pressure, The water used for condensing the ammonia may be transferred to the boiler already mentioned, so that nothing will be wasted.

Regulation of Temperature by means of a Self-Acting Thermometer.—A thermometer intended for this purpose has been invented by General Morin. It is simple and effective; it would seem to be applicable to the prevention of either too high or too low a temperature; and even, by a further development of the principle, to be capable of lowering the temperature by a ventilating apparatus it might set in action; or raising it, by producing a required modification in the supply of heat.

To construct this thermometer, a piece of platinum foil is hermetically fixed in the bulb of the instrument, and another in the stem just at the point to which the mercury will reach, when the temperature is exactly what it should be. These slips of platinum are to be connected with the poles of a galvanic battery, the helix of an electro-magnet forming part of the circuit. When the mercury sinks too low in the stem of the thermometer, battery connection is broken, the electro-magnet loses its excitement, and an armature, which it had previously continued to support, immediately falls. This completes an electric circuit, setting in motion a current which throws a loud alarm into action, and continues to sound its bell until the proper temperature has been reproduced.

A New Caloric Engine. — A new kind of caloric engine has been lately invented in Germany. Its chief peculiarity consists in air being forced for the support of combustion into an air-tight furnace, within which is placed a fireplace of refractory clay. The products of combustion, mixed with a little steam, which is intended principally to furnish a kind of lubrication for the reciprocating portions in contact with it, give motion to two pistons of peculiar construction, after which they escape into the atmosphere. The combustion produced in this way is very energetic, being, it is said, sufficient, when a pressure of about four atmospheres is employed, to fuse malleable iron. Increase of velocity produces an immediate increase in the intensity of combustion; and this increase of intensity reacts at once on the velocity, so that there is a great tendency in this engine to a very rapid motion—which in many cases is a great advantage. It is asserted that, with this arrangement, a much greater calorific effect is obtained from a given amount of fuel than in the ordinary way.

Miscellaneous. — *Improved Bunsen Battery.* — The vapours evolved by the ordinary Bunsen battery are very prejudicial to health. M. Emile Duchemin gets rid of them without a loss of

power, by replacing the nitric acid with an aqueous solution of perchloride of iron. He found that substituting a solution of chloride of sodium for sulphuric acid, left the battery still very effective, and that even if the zinc is surrounded with pure water the battery is well suited for telegraphy.——*Antozone.*—The existence of this substance has been the subject of serious doubt. Schönbein has, however, obtained it, by means of a powerful galvanic battery. He found its specific gravity less than that of hydrogen; it is, therefore, the lightest substance known. It is liquified by a pressure of 150 atmospheres. Mixed with ozone, it is exploded by the non-luminous rays of the spectrum, and by positive, but not by negative electricity. If this latter fact shall have been established by further experiments, it will afford a seemingly unanswerable proof of the existence of *two* electricities.——*New Mode of Softening Photographs.*—M. Mathey, for this purpose, interposes a lace veil between the sitter and the camera—the nearer the latter, the more useful it is. It produces the effect of a drawing in chalks; and softens down prominent characteristics in the model which would impart harshness to the picture.——*New Mode of Silvering Mirrors.*—Two-thirds of an ounce of platinum are dissolved, with the aid of heat, in two ounces and a-half of hydrochloric acid and one ounce and a-sixteenth of nitric acid. The solution is next evaporated, and the residue is pulverized and dissolved in alcohol. The alcoholic solution is applied to the glass, which is then heated to a cherry red, and afterwards cautiously cooled. An excellent, a very durable, and a cheap reflecting surface is thus obtained.——*Application of the Magnesium Light to Medicine.*—The laryngoscope is an instrument consisting of two mirrors, and is used for inspection of the throat, etc. It has been rendered much more effective by employing for its illumination the light of burning magnesium. The rays from the ignited metal are thrown on the mirror situated at the end of the throat, and projected downwards, so as brilliantly to illuminate the larynx and trachea, and form their image in the other mirror. The minute image thus obtained is greatly magnified, by means of a double convex lens, which is held in front of the patient's mouth; and the smallest symptoms of disease in the respiratory passages are rendered distinctly visible. ——*Improvement of the Jaquard Loom.*—The necessity for cumbersome and expensive cards has always been found a source of great inconvenience with this loom; but they have been, at length, rendered unnecessary by M. Acklin, a French engineer, who has substituted for them punched paper, which saves about one-third of the cost, renders lacing—a tedious process—unnecessary, and economizes both labour and time, while it enables the work to be executed more perfectly. The invention is applicable to looms already in use.

NOTES AND MEMORANDA.

THE FLOWING OF ICE AND OTHER SOLIDS UNDER GREAT PRESSURE.—M. Tresca made a second communication to the Academy of Sciences of Paris at a recent sitting, on this very interesting subject. An account of his first paper was given in our Vol. vi., p. 464. He uses a strong cylinder, almost six inches in diameter, and having at its lower end an aperture about two inches in diameter. The more nearly the diameter of the opening approaches that of the cylinder in size, the less the pressure which will be required. To render perceptible the modifications which the bounding surfaces of the different portions of the ice would undergo during their passage through the cylinder and aperture, portions of it were either coloured throughout their masses, or on those faces which constituted the joints. It was found that the ice comported itself in exactly the same way as lead and ceramic pastes had done in the previous experiments, which we have already described. But while a pressure of about 1792 lbs. per square inch, or that of a column of water about 4000 feet high, was sufficient to cause the flowing of the ice, lead had for the same purpose required a pressure of about 9000 lbs., or that of a column of water nearly 20,000 feet high. The effects produced were very remarkable. The surfaces of the joints, originally plain, were changed into concentric tubes, and the ice as it issued from the aperture in the cylinder was furrowed by transverse fissures, so as to resemble a series of discs rather than a continuous solid. This peculiarity had been observed also with the less flexible porcelain pastes. It was apparently dependent on the nature of the material used, and was evidently a secondary phenomenon, which took place after the flowing had happened, and while the ice was actually within the aperture of the cylinder, being due to the cessation of pressure. Each disc consisted of many concentric layers, which must have been produced before the separation into discs occurred. These experiments were believed to throw considerable light on the theory of the movement of glaciers. Superimposed layers were displaced, surfaces were distorted, layers were curved at the extremities of the partial tubes, fissures were produced when pressure ceased, etc., just as in the case of the glaciers. It was remarked that although the ice lost its original form, it did not lose its transparency under the influence of pressure.

DISSOCIATION OF SULPHUROUS ACID.—M. H. Deville, as explained in an article, Vol. iii., p. 191, to which the reader is referred for a description of the apparatus, applies this term to the separation of the constituents of a compound, at a temperature lower than that which would cause complete decomposition. Sulphurous acid transmitted between the tubes he employs, the outer one being at 2192° Fahr., and the inner, which was of plated copper, about 50° Fahr., was decomposed, sulphur being deposited on the silver, but not combining with it; and sulphuric acid being formed with the oxygen, liberated and undecomposed sulphurous acid.

AGE AT WHICH THE MOON CAN BE SEEN.—A subscriber at Runcorn remarks on this subject that he saw the moon on the 8th of February, 1864, when it was little more than 23 hours old. On another occasion he saw it when 43 hours 40 minutes old, and persons to whom he pointed it out said it was the narrowest moon they had ever seen. It is obvious that the early visibility of our satellite will depend upon her latitude at the time, and upon the state of the atmosphere. Mr. Webb obligingly informs us that "Hevelius never saw the moon earlier than 40 hours after conjunction with the sun; and Schröter's nearest points were about 28½ hours on either side. Beer and Mädler saw it 18h. before conjunction, 1834, October 1, when the moon was 11° distant from the sun, and almost vertically over it, 8° 36′ above the horizon." Jews and Mahomedans are likely upon religious grounds to watch for the earliest appearance of a new moon, and it would be interesting to know what their experience has been.

ACTION OF VENUS ON THE SUN.—In the INTELLECTUAL OBSERVER, Vol. v., p. 448, we published a very important paper, by Mr. Balfour Stewart, "On the Origin of the Light of the Sun and Stars," and since that date we have mentioned the further researches of that careful observer. We now find in the *Pro-*

ceedings of the Royal Society a paper detailing additional facts, which tend to show that an external influence operates on the production and behaviour of sun spots. All the planets might act in this way with a force proportioned to their masses and distances, Mercury, Venus, and Jupiter being presumed the most influential, the first from proximity, the second from being both near and tolerably large, and the third from its great size. The question to be resolved is whether the spots break out, increase and decrease in any regular manner, corresponding with the relative positions of planets and the sun. An examination of thirty-two series of spots shows that their behaviour seems to be connected with the positions of Venus "in such a manner that spots dissolve when that part of the sun's surface in which they exist approaches the neighbourhood of this planet, while, on the other hand, as the sun's disc recedes from the planet, spots begin to break out, and reach their maximum on the opposite side."

Diffusion of Crystallized Substances through the Body.—Dr. Bence Jones calls the attention of the Royal Society to facts of this class ascertained by spectrum analysis. He found that if half a grain of lithium was given to a guinea pig for three successive days, it could be detected in every texture of the body.

Insect Metallurgists.—*Cosmos* describes an article by Dr. Sjogreen, a Swedish naturalist, in which it is stated that the particles of pure iron found in Swedish lakes result from the deoxydizing action of certain insects. Their larvæ are stated to absorb oxygen from the oxydes of iron, and to give themselves a coating of the pure metal, which acts like a cocoon, and protects them during metamorphosis.

Report on Spontaneous Generation.—Our readers will recollect that the French Academy appointed a commission to witness and report upon the experiments and counter-experiments of Messrs. Pasteur, Pouchet, etc., on this subject. The experiments hitherto made and reported upon confirm the statements of M. Pasteur that if due pains are taken to destroy existing germs in a fermentible liquid, and to prevent the access of fresh germs, no life is manifested. The liquid used by M. Pasteur was obtained by washing yeast from beer. Other experiments are to be made with infusions of hay during the approaching spring and summer.

Modified Sulphur.—In a former number we mentioned that a modification of sulphur could be produced by fusing it with a little iodine. Messrs. Moutier and Dietzenbach have laid further remarks on this subject before the French Academy. One four hundredth part of iodine changes the sulphur, so that on cooling it remains plastic, and is only partly soluble in sulphide of carbon. Napthaline, paraffine, creosote, camphor, and spirit of turpentine, mingled with sulphur to the extent of one four hundredth or one six hundredth, permit it to cool in a soft ductile state, which passes slowly into the usual hard brittle condition. Oil and wax make the sulphur soft, but leave it entirely soluble in sulphide of carbon. The experimenters have ascertained that the carbon particles effect the change in these cases.

Bond's Discovery in the Orion Nebula.—We learn from the address of the President of the Astronomical Society, as given in *Monthly Notices*, that Professor G. V. Bond, to whom the Society's gold medal was awarded just before his lamented death on the 17th February, discovered "a great re-entering loop of nebulous matter, extending around nearly the whole of the previously known portion, and enclosing as with a nebulous wall a large space exterior to the well-known figure. It was discovered by employing with the 22-feet refractor of 15 inches aperture, an eye-piece magnifying 90 times with a field of 30'."

Abnormal Memory.—The last illness of Friedrich Struve, the late Director of the Poulkowa Observatory, was characterized by a not unusual, but very interesting condition of the memory, which is thus alluded to in the biographical memoir to be found in the *Monthly Notices*:—"When he began to recover from the exhaustion occasioned by the first attack of his malady, his memory, for all events of recent occurrence, wholly failed him, while at the same time it exhibited its usual, or even increased tenacity in things long passed away. On such occasions, he would seem to be living wholly in the scenes of the past, reciting pas-

sages in Greek, Latin, or Hebrew, and speaking in some of the many dialects in which he had learnt to converse in his youth. In the midst, however, of this vivid resuscitation of the past, co-existing with the temporary oblivion of all recent associations, it is a touchingly suggestive circumstance that he never forgot the face of a friend."

DIFFRACTION EXPERIMENTS.—Mr. Bridge informs us, with reference to his apparatus described in our last number, that if the object-glass is removed, and the point of light viewed with the telescope out of focus, a new series of appearances may be obtained, and that by moving the object-glass to and fro to different distances from the eye-glass, a new form of figure is given by each position. Many of the spectra Mr. Bridge considers would offer valuable suggestions to designers of glass windows, carpets, etc.

MICROSCOPE LAMP.—Mr. John Bockett sends us a photograph of his method of mounting and using a microscope lamp. A pillar upon a foot carries a glass lamp with a reflector behind it, and a condensing lens in front. The reflector is about 3½-inches in diameter, and the bull's-eye condenser about 2 inches diameter, and placed a little within the focus of the reflector. A shade is also provided. We have long used and recommended the addition of a silvered reflector behind a lamp. It not only economizes light, but for many purposes improves its quality, as objects may be illuminated almost entirely by the reflected light when the wick is turned low, and thus the glare of the direct flame is avoided. Mr. Bockett burns Belmontine, which gives a whiter light than paraffine.

PROPERTIES OF MUSCULAR TISSUE.—Dr. William Marcet has communicated to the Physical and Natural History Society of Geneva, a paper on the physical properties of muscular tissue. He finds that it is a porous body, and feebly participates in the properties of colloid substances. Its porosity allows it to be traversed by solutions of albumen, which, however, only proceed through it at half the rate of solution of phosphoric acid, thus showing that, like colloid bodies, it opposes a certain obstacle to the transfusion of other colloids, and facilitates the passage of crystalloids. Those to whom these terms are new should read the paper on "Dialysis," Vol. i., p. 381. Physiologists will perceive the relation which Dr. Marcet's researches bear to the question of the nutrition of muscles. Dr. Marcet's paper appears in the *Archives des Sciences*, No. 86.

SIMPLIFIED OPTHALMOSCOPE.—Messrs. Smith, Beck, and Beck have introduced a simplification of Liebreich's Opthalmoscope, which renders this instrument suitable for general use. The optical part is arranged in a single tube, which carries both the mirror and the magnifying lens. The apparatus can be adjusted to any height, and is fitted with a moveable arm, at the extremity of which is a small lamp, furnished with a screen to keep the light off the face of the individual under examination. A rest for the chin is also provided, and the whole packs into a small case.

FOSSIL EQUISETUM IN GNEISS.—M. Elie de Beaumont lately presented to the French Academy a paper by M. A. Sismonda, on a block of gneiss, in the Turin Museum, bearing the impress of a plant, which M. Adolphe Brongniart states is allied to the *Equisetum infundibuliforme* of the coal measures. He proposes to name it *Equisetum Sismondæ*. The block of gneiss appears to have been an erratic from the Valtelline, and belonging to the *infra Liassic* group, which form the general substratum of Alpine sedimentary rocks. At first M. Sismonda thought the markings of a dendritic mineral character, but experiment and observation showed them to be carbonaceous. The discovery of this fossil shows the metamorphic character of the Alpine gneiss.